THE SPIROMETER, THE STETHOSCOPE, & SCALE-BALANCE; THEIR USE IN DISCRIMINATING DISEASES OF THE CHEST, AND THEIR VALUE IN LIFE OFFICES; WITH REMARKS ON THE SELECTION OF LIVES FOR LIFE ASSURANCE COMPANIES,

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SPIROMETER.

1. The Spirometer is an instrument for measuring the volume of air expired from the lungs; and hence arise these questions, viz., What is the volume of air that can be expelled from the lungs? and is this volume the same in all persons; and in the same persons under different conditions of the body, as in health and disease?

2. The respiratory volume which can be discharged from the lungs of a healthy man is a definite and uniform quantity. Nevertheless it is modified by different conditions of the lungs, as also by corporeal form: these modifying the respiratory movements.

3. To understand the application of the Spirometer, as a means of detecting disease in the respiratory organs, and of measuring the respiratory movements, it is necessary to have a determinate idea of these movements and of their differences; and these are most correctly ascertained through the medium of the different volumes of air that are displaced in the act of respiration.

4. *Respiratory volumes.*—The extent of the movements performed by the thoracic bounderies for the purposes of respiration, admits of three degrees of modification:—

a, Extreme expansion (inspiration);

b, Extreme contraction (expiration); and an

c, Intermediate condition (ordinary breathing).

The first two movements displace a larger, and the third movement a smaller volume of air.

The Spirometer measures collectively these three volumes of air; that is to say, the most complete voluntary *expiration* immediately

following the most complete *inspiration*, which we denominate the "VITAL CAPACITY."*

5. The vital capacity volume is the limit of all the requirements for air which man demands. The ordinary breathing is a quiet, gentle, and more limited movement—intermediate in relative position between the most extended breathing movement. According to our requirements it encroaches upon the extreme movement; thus, as we sit quietly, the ordinary breathing movement is scarcely perceptible, but when we use violent exercise, this movement is increased, and extends its limits towards, or into the extreme movement.

6. When any condition prevents this extension of the ordinary breathing movement, we cannot bear extraordinary exertion, and we say, in familiar terms, we are "out of breath;" that is, we demand more air than our thoracic mobility has the means of supplying.

7. Whatever be the cause of this deficiency, as, tubercles, tumours, deformity, or acute inflammation, the Spirometer or breath-measurer expresses this deficiency in the definite language of numbers—definite in their value, and in their comparison. The ordinary breathing movement may, then, be considered to have a spare margin, which is ever at command, a margin absolutely necessary to health. When we cannot command this margin, *i.e.*, extend the ordinary breathing movement into the extraordinary breathing movement, the body is incommoded, and our well-being suffers relatively to the degree of change in the thoracic mobility.

8. The Spirometer measures this margin together with the ordinary breathing; at the same time it determines the permeability of the lungs to air; therefore two conditions are demonstrated, the permeability of the lungs to air, and the mobility of the thoracic boundaries; because we cannot breathe without moving. On the other hand, we cannot determine the permeability of the lungs, through any external measurement, by the extent of mobility of the thoracic boundaries, because we may move without breathing. As a test of the soundness of the lungs, we have chosen the vital capacity

*According to physological nomenclature, perhaps the term *vital capacity* may be objectionable; but we adopt it for want of a better term, it being the largest volume of air which can be displaced by any movement of the living body, and may therefore be termed *vital volume* or the vital capacity.

volume instead of the ordinary breathing volume, for two reasons: first, because the vital capacity volume is from 12 to 20 times greater than the ordinary breathing volume, and an error of a few cubic inches in the larger volume is of no consequence; while, secondly, in the smaller volume (ordinary breathing) a few cubic inches is of such importance, as to disguise the correct measurement of the natural breathing volume. Such error is sure to be introduced into the observation as soon as the mind of the examinee is directed towards the object of our experiment; consequently many hundreds of ordinary breathing volumes would have to be measured until the mind was averted from the observation, and the mean of these, must then be taken as the ordinary breathing volume; whereas one or two observations of the vital capacity, (which is only perfect when the mind is directed towards it), will determine the correct measure of that volume.

9. *Vital capacity volume.*—The measure of this volume is modified by height, by attitude, by weight, by age, and by disease.

10. *First,—The vital capacity as affected by height.*

The vital capacity is the same in all men of the same stature, quite irrespectively of the size of the chest; and as the height of men differs, the measurement of this volume differs, and that too in an arithmetical ratio. Thus, a man of 5ft. 8in. can breathe 230 cubic inches of air (at 60 F.) at one expiration, and a man one inch taller 238 cubic inches, by a similar effort. On the other hand, a man one inch shorter, namely, 5ft. 7in., can only breathe 222 cubic inches, being 8 cubic inches less than the man of 5ft. 8in.; hence is elicited the following law:—THAT IN THE ERECT POSITION, FOR EVERY INCH OF STATURE FROM 5FT. TO 6FT. EIGHT ADDITIONAL CUBIC INCHES OF AIR, AT 60 F., ARE GIVEN OUT IN ONE VOLUME, BY THE DEEPEST EXPIRATION, IMMEDIATELY FOLLOWING THE DEEPEST INSPIRATION. The thoracic mobility therefore increases and decreases with the height, according to an arithmetical progression.

11. The following Table has been determined by experiment, upon men of all classes in society, at all heights between 5ft. and 6ft., irrespective of all thoracic dimensions.

TABLE I.—THE VITAL CAPACITY (AT 60 F.) OF THE HEALTHY LUNGS, IN THE ERECT POSITION, FROM 4400 MALES.

HEIGHT.				FRENCH MEASURE.			MEAN.			MINIMUM.
ft.	in.		ft.	in.	Mètrs.	Mètrs.	Age. 15 to 55.	Age. 55 to 65.	Age. 65 to 75.	16 per cent. below the mean.
5	0	to	5	1	1.514	à 1.549	174	163	161	146
5	1	„	5	2	1.549	— 1.575	182	173	168	153
5	2	„	5	3	1.575	— 1.600	190	181	175	160
5	3	„	5	4	1.600	— 1.626	198	188	182	166
5	4	„	5	5	1.626	— 1.651	206	196	190	173
5	5	„	5	6	1.651	— 1.676	214	203	197	180
5	6	„	5	7	1.676	— 1.702	222	211	204	187
5	7	„	5	8	1.702	— 1.727	230	219	212	193
5	8	„	5	9	1.727	— 1.753	238	226	219	200
5	9	„	5	10	1.753	— 1.778	246	234	226	207
5	10	„	5	11	1.778	— 1.803	254	242	234	213
5	11	„	6	0	1.803	— 1.828	262	249	241	220

12. The first column, between the ages of 15 and 55, is the most to be depended upon, and to this we always refer, because, it is gathered from observation: the next two columns will be understood are derived from calculation. The last column is what we affix for the lowest healthy admeasurement. As the vital capacity of this table is the mean of 4400 observations, it will be understood that some men, although of the same stature, breathe more, and some less,—and a common question put to us is, How little may a man breathe, and

yet be healthy? From our experience we place this limit at 16 per cent. below the mean. A difference of only 5 or 10 cubic inches relative to the first column is of no consequence; but, if instead of breathing 230 cubic inches, 193 cubic inches be exhaled, then the case must be carefully examined, for some preternatural cause *must exist* to produce this effect. Knowing the mean and minimum of the healthy volume of air, we can determine the amount of disease in the lungs by the degree of difference from this.

13. As the volume of expired air is relative to the measurement of the walls of the chest, we may, in the absence of the Spirometer, roughly measure this mobility by the common tape measure; thus, we may pass the tape measure round the chest (standing in front of the patient) over the nipples, and then request the patient to *inspire deeply*, and note the number of inches on the measure, this the maximum circumference; then without moving the tape, we should request him to expire to his utmost, here again noting the minimum circumference, and the difference will be the mobility of the chest; for instance, if the maximum circumference be 36 inches and the minimum 33 inches, the difference is 3 inches, and 3 inches is the mobility of the chest.

14. Without the tape measure, the hand can become so educated in measuring the chest mobility, that tolerably accurate information can be obtained by it alone, if the patient breathes his proper quantity, or if his lungs are healthy. To do this, we should stand behind the patient and grasp the top of the shoulder, the thumbs resting upon the supra-spinous fossa of the scapulæ and the fingers extending in front down over the clavicle: in this way we command a good grip of the apex of the chest; if healthy, the apex in inspiration will swell up under our hands, and a little practice soon teaches us the healthy expansion, for if the lungs expand at the apex they are healthy everywhere else. The mobility of the chest is sometimes non-symmetrical in its movements; the hands in the same position as just mentioned likewise detect this. An instrument termed *Stethometer* has been constructed by Dr. Richard Quain for expressing the non-symmetrical movement in figures. It is a small instrument, not larger than a watch, with a graduated dial and pointer. It is

placed upon any part of the chest, and a silken cord from it is fixed upon any other part less moveable; the extension between these points is indicated by the pointer (which is moved by the silken cord), as to 35 or 40, &c., and thus comparisions are made of the different parts of the chest. In a healthy man the mobility of the chest varies from 3 to 5 inches; when it is 3 inches, the vital capacity corresponds with the numbers given in the first column of Table I., page 4.—A mobility of 5 inches is very rare.

15. Although the vital capacity increases with the stature, yet the absolute admeasurement of the chest does not augment in any of its dimensions with the general height; because the volume of breath is relative to the mobility of the thoracic boundaries, just as the volume of blast from the common domestic bellows is chiefly relative to the movement of the walls of that machine, and not to its absolute size; for instance, two bellows of exactly the *same* dimensions, the one made of fine kid leather and the other of some thick hide, would displace dissimilar volumes of air, because their mobility would be dissimilar. For the same reason a different mobility in two chests of corresponding dimensions will give different volumes of air, therefore the absolute dimensions of the chest under certain conditions is not a guide to estimate the volume of the vital capacity. We cannot however at present assign any reason why the vital capacity should increase with the stature.*

The numbers expressing the vital capacity may be viewed as an index or exponent of the permeability of the lungs to air, as well as of the relative thoracic mobility.

16. Whatever, therefore, interferes with the permeability of the lungs to air, or impedes the breathing movements, is measured and expressed in figures by the Spirometer.

17. We are frequently asked, "Does your table of vital capacity answer to the vital capacity of women?" This table is derived only from experiments upon men. We do not know the vital capacity of women, nor is it easy to determine it, because of their tight dress; independently of this we see no reason why their vital capacity

* *Med. Chir. Tran.*, vol. 29, p. 175, and Art. "Thorax," *Encyclopædia of Anat. and Physiology.*

should not correspond with that of men, for their chest mobility appears to exceed that of men. As the purpose of respiration is to aïrate the blood, and as the volume of the blood in all probability is relative to the general weight of the person, and as the weight of women, relative to their height, is, we believe, equal to that of men, why should not their breathing volume be the same? The more so, as during gestation they have to vitilize more blood than at other times. However, if women do breathe less than men, this difference must be made up by the vigour of their lungs, for certainly they do not live upon blood less oxygentrated than men. Where we have measured the vital capacity of women, incommoded by dress, we found their vital capacity so closely corresponding to that of men, that if observations were extended probably no difference would appear. But when clothed, as women in this country are wont to attire, they all seem to breathe the same volume as if they all lived under one uniform tightness in dress. However, this is still open to investigation.

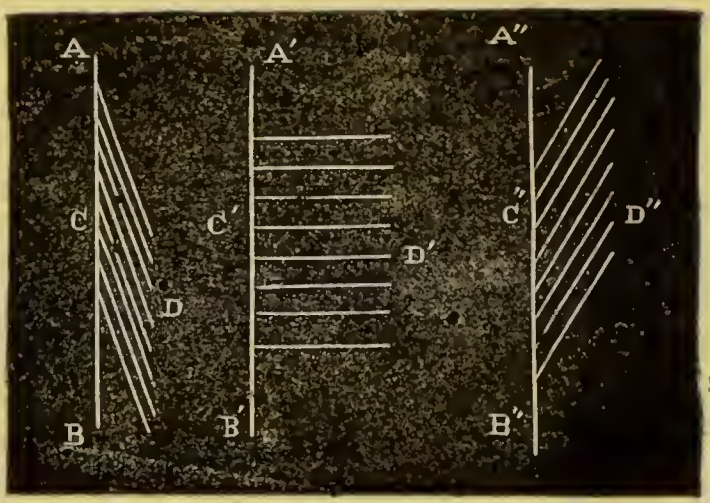
18. *Secondly,—Vital capacity as affected by position.*—The vital capacity is greatest in the erect position; therefore, in comparative observations, the posture of the body must always be the same. We found that our own vital capacity was:—

	Cubic inches.
Standing	260
Sitting	255
Recumbent (supine)	230
Recumbent (prone)	220

19. Hence position modifies the permeability of the lungs 40 cubic inches; and if we had sat with the body doubled up, like miners in the low gallery of a mine, the vital capacity would be diminished more than 100 cubic inches. Position thus affecting the breathing volumes, the posture of the body should be considered in the treatment of diseases of the spine; for a patient lying upon his face will have less power to aïrate the blood than one lying upon his back. In angular curvature of the spine, the vital capacity is small, sometimes not one-third of the healthy volume, because the patient cannot straighten his back.

20. *Thoracic expansion.*—The following diagram will explain how the thorax increases and diminishes its capacity. Let A B, *fig.* 1, represent the erect spine; D the ribs, at an angle say of

Fig. 1.



40° to the spine: if we elevate these ribs to an angle of 90° to the spine, as at D′ at A′ B′, two new conditions will be observed: the perpendicular distances between the bar have increased, and their free ends D′ have receded from the body A′ B′. Were the bars still

Fig. 2.

more elevated (beyond 90°) both these conditions would again diminish in D″ to A″ B″, as they had previously increased between 40° at D and 90° at D′. Therefore the ribs only increase the capacity of the chest while their angle to the spine is increasing from 0° to 90°; beyond this point the capacity dimishes again, with a continuation of the same movement. In like manner let us suppose the spine not to be erect, as A, D′, B, *fig.* 2, where the collective movement of the bars does not uniformly enlarge that space, for while the lower ribs at D″ and D′ are ascending towards 90° and increasing the area they cover, the upper bars D, moving upwards in the common movement, would decrease their area, somewhat like the folding up of a lady's fan. Therefore the volume of air displaced by rib movement is always relative to the obliquity of the ribs to the spine, and the more obliquely we can place them, which can be done by straightening the spine, the greater the range of movement increasing the thoracic capacity; hence in the erect position we breathe the largest volume of air, and in the stooping position the smallest volume of air.

21. In fact, it is possible for a man to breathe without either the ribs or diaphragm moving, by bending and straightening his spine.

22. *Thirdly,—Vital capacity as affected by weight.*—The scales are *invaluable* in examining chest diseases; because we *cannot* have consumption without a diminution of weight as the first symptom of that complaint.* There are three kinds of weight:—

Weight in excess, or corpulency;
Natural weight, as healthy weight; and
Emaciated weight, diseased weight.

23. *Weight in excess* begins mechanically to diminish the breathing movements, when it has increased to 7 per cent. beyond the mean weight, (103.) From this point the vital capacity decreases 1 cubic inch per lb. for the next 35 lbs. above the 7 per cent. increase. It is probable that beyond this the vital capacity decreases in a geometrical progression. The ordinary weight of man

*See "Symptoms of Consumption," *Medical Times*, August 10 and 24; September 7, 1850; and January 4, 1851.

increases with the height, and that probably about 6½ lbs. per inch of stature.* *The diseased weight* of consumption is considerably below the natural weight. (See Table of Weight). For example, if a man of 5ft. 8in. weighs 166 lbs., his vital capacity may still be expected to correspond with our table, (Table I.,) but for every lb. above this, for the next 35 lbs. we may allow 1 cubic inch per lb.; therefore if he weigh at 5ft. 8in., say 170 lbs., instead of 166 lbs., we deduct 4 cubic inches, as diminished by excess weight. We do not make the correction for weight, unless the weight is much in excess, *i.e.*, unless there is a corpulent appearance.

24. *Fourthly,—Vital capacity as affected by age.*—The effect of age upon the vital capacity is less manifest than the conditions above mentioned; indeed its influence was not noticed until 1012 cases had been examined, while that of height was perceived in the first 50 cases. By calculation, from 15 to 35 years of age the vital capacity was increased, and from 35 to 65 years it was decreased. But by experiment this is not so constantly found to be the case. The result of calculation is, that the decrease of the vital capacity, from 35 to 65 years of age, is in the relation of 19, 11, and 13 cubic inches, for three consecutive periods of 10 years each, *i.e.*, equal to 43 cubic inches or 1.43 (nearly 1½ cubic inches) per year, or 7 cubic inches in 5 years, or 14¾ cubic inches for 10 years. Although this influence appears by calculation in the mass of 4000 cases, yet we recommend from experience, that the effect of age may be more diminished, allowing a person to attain the age of 55 years before any substraction is made for age, then an allowance be made for two periods of 10 years each, up to 75 years of age. This is given in Table I. For example, a man of 5ft. 8in., of the mean weight, may be expected to breathe 230 cubic inches until the age of 55, and from 55 to 65 years 219 cubic inches, and from 65 to 75 years of age 212 cubic inches.

25. Ossification of the cartilages of the ribs has no influence in diminishing the powers of breathing.†

26. *Fifthly,—Vital capacity as affected by disease.*—This

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*Vide *Med. Chir. Trans.*, vol. 29, p. 124.
†Art. "Thorax," *Cyclopædia Anat. and Physiol.*

marks the value of the Spirometer—the broad difference between the healthy volume of expired air and the limited volume caused by disease generally, and particularly by thoracic diseases. We have shown that the healthy volume of air is relative to the degree of thoracic mobility; therefore whatever interferes with the breathing mobility is perceived by the number of cubic inches deficient in the volume of the vital capacity. It may be safely said, that all thoracic or abdominal diseases, as tumours or acute inflammation, or infiltration of fluid or the presence of solid matter in the respiratory organs, or bordering upon the parts comprising the thoraxic cavities, immediately and for so much diminishes the breathing movement, and hence the vital capacity. Moreover, every thing affecting the hard parts, as disease of the spine or ribs, whether angular or lateral curvature, or the stoop produced by vocation or age, or by any disease whatsoever, is manifested by the measure of the vital capacity through the Spirometer. Likewise whatsoever prevents the free ingress of air into the lungs, be the same organic or functional, as asthma, emphisema, bronchitis, or phthisis pulmonalis, is shown by the Spirometer.

27. It requires no more education to discriminate the effect of such disturbing causes, than it does to distinguish a difference in the value between 3 and 4. If the vital capacity should be 230, and we find it 154, as certain as that 230 is not 154, just so certain is it that some abnormal cause exists, to produce this difference of 75 cubic inches. Then follows the question, What is the cause of this difference? Collateral observations and the history of the case must guide us: our deduction may be wrong, *i.e.*, it may not proceed from the cause to which we have attributed it; nevertheless, 230 is not 154, and we must look again for another cause, and though we never find the cause, yet 230 is not 154. And so the Spirometer observations never bend to what we wish or think upon the cause of the difference between two numbers. A disputed case was once referred to us: some said there were tubercles and adhesions; others said not; the man gave 270 cubic inches of air out of his lungs: we said nothing, for the fact of this observation

told like the moral of a fable, a deduction couched without words, not to be rejected, viz., that the lungs were highly permeable to air, and that the mobility was good. Can a man breathe a volume according to our table, and have phthisis pulmonalis? We have never seen it; and we have seen more than 600 phthisical persons breathe into the Spirometer. Some persons have said the contrary; but was there phthisis? How often has it been said, that a person has phthisis, who had not phthisis. The Spirometer has stood as a *test* in the Hospital for Consumption; and by their Report, p. 26, there is a difference between health and disease of 33 per cent, and the authors of that Report add, "That the Spirometer gives distinct indications, at an early period of the malady, and that these indications become more obvious, in proportion to the progress of the disease."*

28. Phthisis pulmonalis seriously diminishes the vital capacity. This difference is not entirely due to the deposition of tubercular matter, for we have found that when this did not exceed a few grains,† the vital capacity was deficient 47 cubic inches: yet at the same time, it is true, that with an increasing deposition of solid matter, we have a diminishing vital capacity.

29. When consumption begins to localize itself in the chest, the back stoops, and the shoulders are turned forwards and inwards; this position is fixed as it advances, yet creeps gradually onwards; the curling in, as it were, of the apex of the chest, diminishing the mobility and the expanding power of the ribs; hence a reason why the vital capacity is decreased. Probably the breathing POWER diminishes also; for the muscular power in contending against the elasticity of the ribs, during ordinary breathing, has a constant struggle against the resistance of 100lbs., (vide "Thorax," *Cyclopædia Anat. Phys.*,) and in deep breathing, to more than three times this resistance. Or eles this strong expiratory and collapsing elastic power of the ribs and lungs being constant, whilst the muscular power decreases, this elastic resistance becomes in a measure too great for the sinking vital energies.

*The Author never saw this Report until it was published, and a copy was presented to him.

†*Med. Chir. Trans.*, vol 29, p. 221, par. 173.

TABLE II.—HEALTHY & DISEASED VITAL CAPACITY COMPARED, FROM 400 PHTHISICAL MALES.

HEIGHT.				HEALTH.	PHTHISIS PULMONALIS.		
Ft.	In.	Ft.	In.	Cubic Inches.	1st Stage. 33 per cent.	2nd Stage. 53 per cent.	Mixed. 43 per cent.
5	0 to	5	1	174	117	82	99
5	1 —	5	2	182	122	86	102
5	2 —	5	3	190	127	89	108
5	3 —	5	4	198	133	93	113
5	4 —	5	5	206	138	97	117
5	5 —	5	6	214	143	100	122
5	6 —	5	7	222	149	104	127
5	7 —	5	8	230	154	108	131
5	8 —	5	9	238	159	112	136
5	9 —	5	10	246	165	116	140
5	10 —	5	11	254	170	119	145
5	11 —	6	0	262	176	123	149

This table reads thus:—a man between 5ft. 7in. and 5ft. 8in., in health, should breathe 230 cubic inches; in the first stage of consumption, 154 cubic inches; in the second stage, 108 cubic inches; and between these stages, 131 cubic inches.

29. This difference of from 33 to 53 per cent., is the effect of consumption. We shall often times find a deficiency of 33 per cent. when only those morbid stethoscopic sounds are heard which indicate the friction-sound of air in the tubes to be charged — (52) — as harsh or feeble respiration, instead of the soft vesicular murmur which gives the healthy volume. This table gives conclusive evidence of the use of measuring the breath in examining the chest: for the experiment gives confidence according to the result. The greatest difference we have noticed in the first stage of consumption, was 80 instead of 230 cubic inches, and in the second stage, 70 instead of 262 cubic inches. By the first stage is meant when crude tubercles are in the lungs and by the second stage when tubercles are softening or breaking up.

30. We could relate many cases to show the sensitiveness of the Spirometer test in the early stages of consumption, but probably one

case may suffice for illustration. We shall notice the case of Freeman, the "American Giant":—

This man came over to England in 1842, and in the November of that year, trained for a prize fight; we examined him immediately before his *professional engagement*, when he might be considered in the "best condition." His powers were as follows:—Vital capacity, 434 cubic inches; height 6ft. 11¼in.; weight, 19st. 5lb.; circumference of his chest, 47 inches; inspiratory power, 5.0 inches; expiratory power, 6.5 inches. In November, 1844, exactly two years afterwards, he came to town in ill health. We then examined him in the same way as before, twenty times at various intervals, during which his vital capacity varied from 390 to 340, and the mean of all the observations, was 344 cubic inches, a decrease of 90, or more than 20 per cent.; his respiratory *power* had decreased one-fifth, and his weight 2 stone. At this time we took him to two physicians well skilled in auscultation, and they *both affirmed* that they could *not detect* any organic disease. After January, 1845, we lost sight of Freeman, and, in the October following, we were kindly favored with the following account of him, from Mr. Paul, Surgeon to the County Hospital, Winchester.

"Freeman was admitted into this hospital on the 8th of October, in an extreme state of debility and exhaustion; he was reduced almost to a skeleton, complained of cough, and was expectorating pus in large quantities. Percussion on the anterior part of the chest *under the clavicles*, gave, on the right side, a very dull sound; on the left one, much clearer, but still I think less resonant than natural; I made but one attempt at auscultation, but could come to no conclusion, from a rather singular reason—the ribs were so large, the intercostal spaces so wide, and so sunk in, from the extreme state of emaciation to which Freeman was reduced, that I could not find a level space large enough to receive the end of the stetheseope; could not, in short, bring its whole surface into contact with the chest. Freeman's great debility, and the clearness of the diagnosis from other sources, prevented my repeating the attempt. Freeman, after death, measured 6ft. 7½in., and weighed 10st. 1lb. On opening the chest, the lungs, on both sides, were found adhering by

their apices to the superior boundaries of the thorax, and studded throughout their substance with tubercles. The tubercles, on the whole, were much less numerous in the right lungs than in the left; both lungs were nearly healthy at their base; the tubercular matter gradually increased in quantity towards their inner parts, and the apices of both lungs were almost completely occupied by large cavities, partly filled with pus, and capable of containing two or three ounces of fluid each. The heart was remarkably small. The rest of the viscera appeared healthy."

It is very remarkable to see that Freeman lost so much weight; in his prime he never appeared stout, but strong and muscular. We have been informed, when he came first to England, his weight was 22 stone; he died 10 stone; his natural height was 7ft., and he died 6ft. 7½in. Such was the effect of consumption upon the finest formed man.

The Spirometer was useful in this case, by indicating the commencement of that disease which ultimately caused his death, and that BEFORE THE USUAL MEANS AVAILED.

31. To MEASURE THE VITAL CAPACITY OF THE LUNGS.

When the vital capacity of the lungs is to be tested, let the person to be examined loose his vest, *stand perfectly erect* (see the annexed figure) with the head thrown well back; *slowly* and *effectually* fill his chest with air, or *inspire* as deeply as *possible,* then put the mouth-piece between the lips, (standing in the same erect position), holding it there sufficiently tight, as not to allow any breath to escape. The observer in the meantime turns open the tap c, *fig.* 3, immediately the patient empties his lungs, and *slowly makes the deepest expiration;* at the *termination* of which, the operator turns off the tap, confining in the receiver the expired air, which part of the Spirometer is now raised out of the reservoir, as represented in *fig.*, 3.

To measure the quantity of air breathed into the Spirometer, the receiver must be depressed lightly with the right hand, until the surfaces of the spirit in the bent tube are level with each other, then the index will cut the degree upon the scale, which numbers the cubic

inches of air breathed from the lungs. Each degree upon the scale measures two cubic inches. Thus is determined the *vital capacity* of the lungs.

32. *Correction for temperature.*—The air in the lungs is about the temperature of the body, 98°, but the water in the Spirometer is generally about 60°; therefore the natural temperature of the breath is diminished in volume whilst passing into the Spirometer; but sometimes, in winter and in summer likewise, the temperature of the water (which is the same as the temperature of the room) is considerably above or below 60°. Our table, (Table I.,), is calculated for 60°; but in the extreme of the season, and when a case of doubt is before us, a correction should be made for the difference of 10 or 12 degrees, caused by the seasons. This correction may be done as follows:—The bulk of air changes $\frac{1}{300}$ for every degree F. of variation of temperature: if a man breathe in winter 295 cubic inches of air into the Spirometer when at 55°, or 5 degrees below 60°, then $\frac{5}{300}$ must be added to the 295 cubic inches, thus: $\frac{5}{300} = \frac{1}{100}$ 295 × 1 = 295 ÷ 100 = 2.95 cubic inches, added to 295 = 297.95, or in round numbers, 298 cubic inches. On the other hand, if the vital capacity be determined as 215 cubic inches when the thermometer stands at 72°, which is 12 degrees *above* 60°, $\frac{12}{300}$ must be deducted, thus: $\frac{12}{300} = \frac{1}{42}$·215 × 1 = 215 ÷ 42 = 5 cubic inches to be substracted, making the corrected observation as 210, instead of 215 cubic inches. In a little time the operator can make these corrections without pen or paper. Every one of our observations have been corrected for temperature.

33. We notice this correction rather for those who may wish to extend enquiries, than for those who employ the Spirometer for private use; because, as the water in the instrument is seldom above or below 60°, and as a difference of 16 per cent. in the vital capacity is allowed as a minimum, natural changes of temperature, change the vital capacity only some two or three per cent.; and this is not sufficient to excite alarm in the admeasurement obtained. However, as in instances of life assurance, where a case is of uncertain appearance, it is well to consider the correction for temperature, in order that the applicant may have every just advantage. We here present a table for this correction, which will facilitate the operation.

TABLE III.—FOR THE CORRECTION OF TEMPERATURE,

REDUCING THE VITAL CAPACITY TO THE TEMPERATURE OF 60°.

Vital Capacity	50°	52°	54°	56°	58°	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	82°
50	51	51	51	50	50	50	50	50	49	49	49	49	49	48	48	48
55	56	56	55	55	55	55	55	55	54	54	54	54	54	53	53	53
60	61	61	61	60	60	60	60	60	59	59	59	59	58	58	58	57
65	66	66	65	65	65	65	65	65	64	64	64	63	63	63	63	62
70	71	71	70	70	70	70	70	69	69	69	68	68	68	68	67	67
75	76	76	75	75	75	75	75	74	74	74	73	73	73	72	72	72
80	81	81	81	80	80	80	80	79	79	79	78	78	77	77	77	76
85	86	86	86	85	85	85	85	84	84	84	83	83	82	82	82	81
90	92	92	91	90	90	90	90	89	89	88	88	88	87	87	87	86
95	97	97	96	95	95	95	95	94	94	94	93	93	92	92	91	91
100	102	102	101	101	100	100	100	99	99	98	98	97	97	96	96	95
105	107	107	106	106	105	105	105	104	104	103	103	102	102	201	101	100
110	112	112	111	111	110	110	110	109	109	108	108	107	107	106	106	105
115	117	117	116	116	115	115	114	114	113	113	112	112	112	111	111	110
120	122	122	121	121	120	120	119	119	118	118	117	117	116	116	115	115
125	127	127	126	125	125	125	124	124	123	123	122	122	121	121	120	120
130	132	132	131	131	130	130	129	129	128	128	127	127	126	126	125	124
135	138	138	137	136	135	135	134	134	133	133	132	132	131	130	130	129
140	143	142	142	141	140	140	139	139	138	137	137	136	136	135	135	134
145	148	147	147	146	145	145	144	141	143	142	142	141	141	140	139	139
150	153	152	152	151	151	149	149	148	148	147	146	146	145	141	141	143
155	158	157	157	156	156	155	154	153	153	152	151	151	150	149	149	148
160	163	163	162	161	161	159	159	158	157	157	156	155	155	154	154	153
165	168	168	167	166	166	164	164	163	162	162	161	160	160	159	158	157
170	173	173	172	171	171	169	169	168	167	167	166	165	165	161	163	162
175	178	178	177	176	176	174	174	173	172	172	171	170	169	168	168	167
180	184	183	182	181	181	179	179	178	177	176	176	175	174	173	173	172
185	189	188	187	186	186	184	184	183	182	181	180	180	179	178	178	177
190	194	193	192	192	191	189	188	188	187	186	185	185	184	183	182	181
195	199	198	197	197	196	194	193	193	192	191	190	189	189	188	187	186
200	204	203	202	202	201	199	198	198	197	196	195	191	194	192	191	191
205	209	208	207	207	206	204	203	203	202	201	200	199	198	197	196	196
210	214	213	212	212	211	209	208	208	207	206	205	204	203	202	201	201
215	219	218	217	217	216	214	213	213	212	211	210	209	208	207	206	206
220	224	223	222	222	221	219	218	218	217	216	215	214	213	212	211	210
225	229	229	228	227	226	224	223	222	221	221	220	219	218	217	216	215
230	235	234	233	232	231	229	228	227	226	225	224	223	223	221	221	220
235	240	239	238	237	236	234	233	232	231	230	229	228	227	226	226	225
240	245	244	243	242	241	239	238	237	236	235	234	233	232	231	230	229
245	250	249	248	247	246	244	243	242	241	240	239	238	237	236	235	234
250	255	254	253	252	251	249	248	247	246	245	244	243	242	241	239	239
255	260	259	258	257	256	254	253	252	251	250	249	248	247	246	245	243
260	265	264	263	262	261	259	258	257	256	255	254	253	252	250	250	248
265	270	269	268	267	266	264	263	262	261	260	259	257	256	155	254	253
270	275	274	273	272	271	269	268	267	266	265	263	262	261	260	259	258
275	280	279	278	277	276	274	273	272	271	270	268	267	266	265	264	262
280	286	285	283	282	281	279	278	277	275	274	273	272	271	270	269	267
285	291	290	288	287	286	284	283	282	280	279	278	277	276	274	274	272
290	296	295	293	292	291	289	288	287	285	284	283	282	281	279	278	277
295	301	300	299	297	296	294	293	291	290	289	288	287	286	284	283	282
300	306	305	304	302	301	299	298	296	295	294	293	292	290	289	288	286
305	311	310	309	307	306	304	303	301	300	299	298	296	295	294	293	291
310	316	315	314	312	311	309	308	306	305	304	302	301	300	299	298	296
315	321	320	319	318	316	314	312	311	310	309	307	306	305	303	302	301
320	326	325	324	323	321	319	317	316	315	314	312	311	310	308	307	306
325	331	330	329	328	326	324	322	321	320	319	317	316	315	313	312	310
330	337	335	334	333	331	329	327	326	325	323	322	32	319	318	317	315

34. Whatever vital capicity be determined, look for the same number in the *first column*; then look for the corresponding temperature to that of the room, in the top row of figures; carry the eye down that column to the row corresponding with the vital capacity, (just as you come to the product of two numbers in the multiplication table), and here you have the vital capacity corrected for 60°. Thus, if a man breath 280 cubic inches at 76°, the correction is 271 at 60°; or if 280 at 50°, you have 286 cubic inches.

35. *Description of, and directions to arrange the Spirometer.*—The Spirometer is merely a vessel or receiver, inverted in another vessel, which contains water, like an inverted wine glass in a tumbler of water; by means of a flexible tube, communication is made with the inverted receiver, and air is blown into it: the receiver then rises, assisted by counterbalance weights; the degree of ascent, being according to the volume of air introduced. Such instruments have been known for 50 years past as Pulmometres; but, hitherto, no table of the capacity of the lungs was worked out; therefore the Pulmometres never became useful.

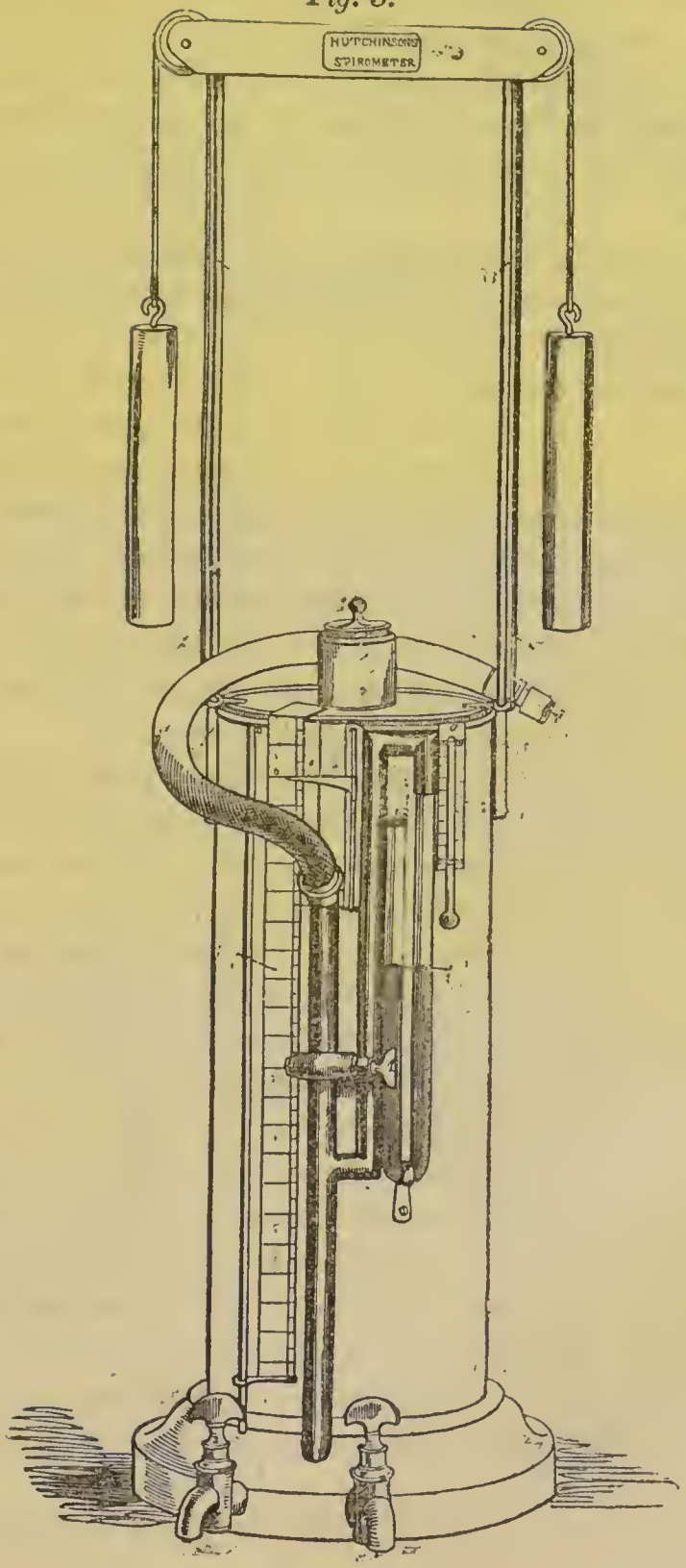
36. Three kinds of Spirometers have been constructed, all equally correct, but different in price. The most expensive kind (21*l.*) we shall here omit to describe, and notice the two kinds now used in England and on the Continent.*

Japanned Spirometer.—This is the cheapest description of instrument and now most in use, and is represented by *fig.* 4: it supersedes by its simplicity one of earlier date, represented in *fig.* 3, which latter instrument is not now manufactured. The chief difference between the two, is, that the counterbalance weights slide in a tube in *fig.* 4, but are exposed in *fig.* 3; so that if the cord should wear through, in the instrument represented in *fig.* 4, nothing is injured by the fall of the weight. Likewise one of the taps in *fig.* 3, at the bottom, is dispensed with. We shall confine ourselves to the description of *fig.* 4.

37. *Directions.*—We should place the instrument upon a firm table or stand, 3 feet from the ground, and take out the valve D,

*Specimens of each was exhibited in the "Crystal Palace," in the Surgeons' Instrument Department.

Fig. 3.



then attach the counterbalance weights (if not sent attached) to each cord, having passed them over the pullies AA, and then suspended them in the tubes BB, the pullies are kept in their right position by an appropriate adjustment to the top of the tubes BB; the receiver now ascends to the cross-head extending between the pillars, BB.

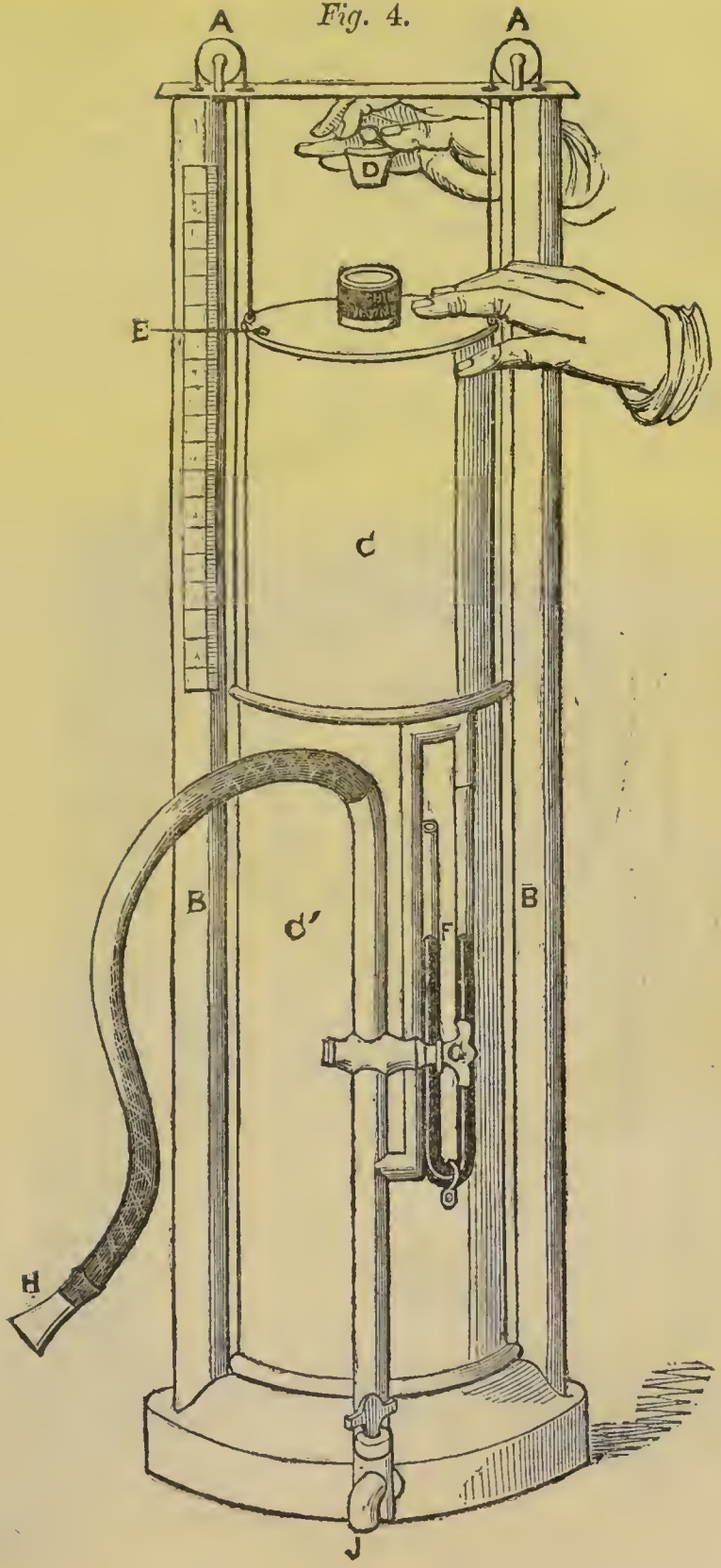
We next pour a little coloured spirit into the bent glass tube or pressure guage F, until it rises about $3\frac{1}{2}$ inches in both legs of this tube.

Now pour into the spout at the back of the Spirometer clear cold water, until it is seen about 2 inches from the brim, or at the bottom of the spout, then turn off the air tap G, and press down the receiver C to the bottom of the reservoir C′, and lastly return the valve D into its socket—when the Spirometer will be ready for use. It will now be seen that the coloured spirit in the bent tubes has its two surfaces at different levels: because the receiver C, has slightly risen, in consequence merely, of the counterbalance weights being somewhat heavier than the receiver C, but this is of no importance.

Use of the bent tube or differential pressure guage.—This tube communicates the external air, or the air of the room with the air in the receiver. The coloured fluid in the tube obstructs this communication, and yet, by its freedom of movement, shows when the water WITHIN the receiver C, is level or otherwise, with the water on the OUTSIDE of the receiver; thus, when the coloured spirit is relatively level in both legs of this tube, then the water likewise, IN the receiver, is level with the water on the OUTSIDE of the receiver, and the index E cuts the degree on the scale which notes the cubic inches of air contained in the receiver; but, when the two surfaces of the coloured spirit are not relatively level, neither is the water *in* the receiver, level with the water on the *outside* of the receiver. The most familiar example of the inequality of the surface of water, is seen in the displacement of gasses into a glass jar over the pneumatic trough, where the surface of the water IN the glass receiver, may, or may not, be level with the surface of the water in the trough.

Therefore, it must be always recollected, that in determining the

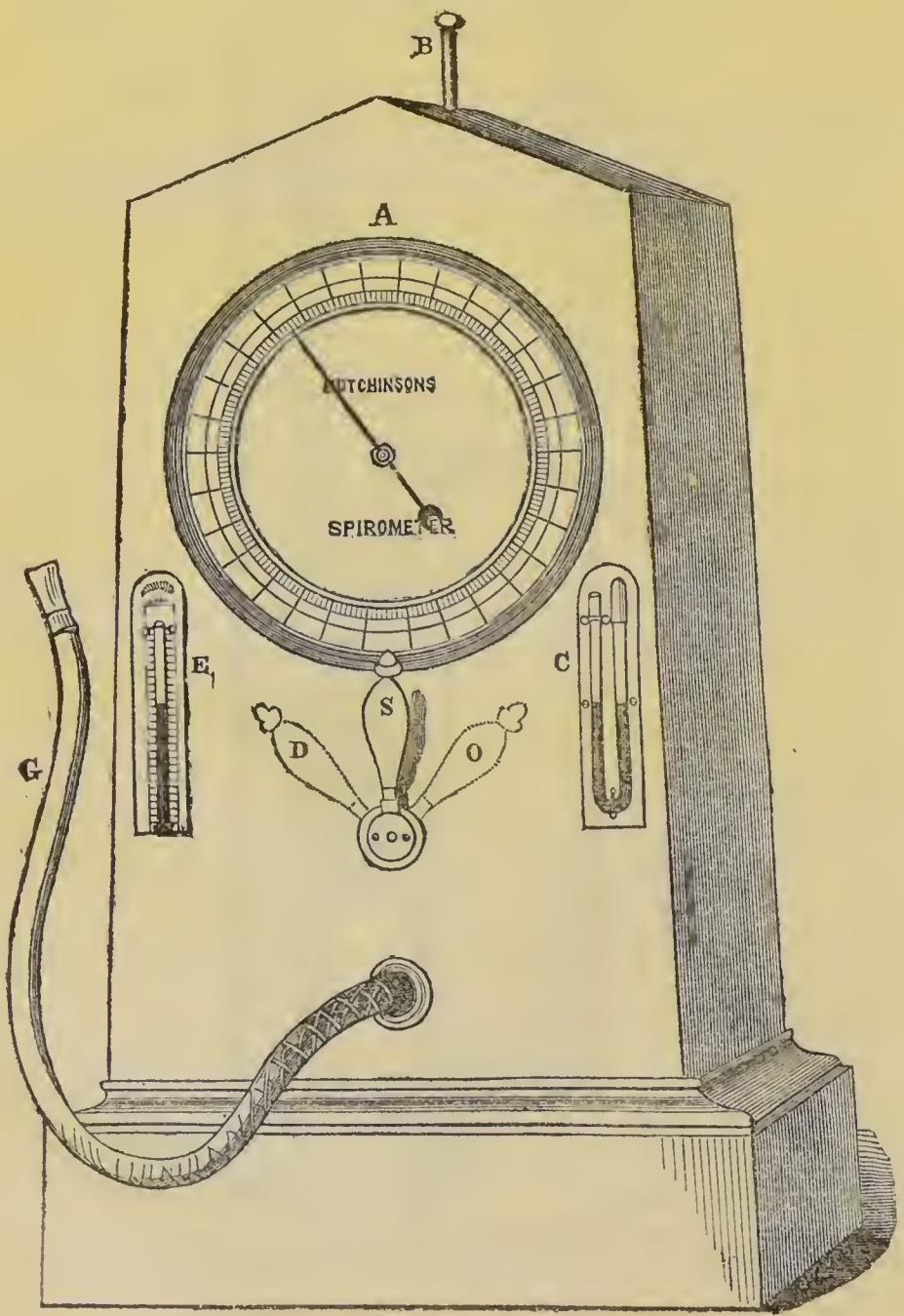
Fig. 4.



volume in cubic inches (of breath, or any gas) discharged into the receiver, the coloured spirit in the bent tube, MUST BE RELATIVELY LEVEL IN EACH LEG, (which is done, by gently depressing the receiver C,) before we can correctly read the vital capacity, or volume of gas measured by the Spirometer.

39. *Dial-face Spirometer.*—This is also of japanned zinc, or

Fig. 5.



Spanish mahogany and constructed of a form more pleasing, but *not* more correct for admeasurement, than that described by *fig.* 4; therefore the difference between the two Spirometers, merely consists in the appearance. We represent this instrument by *fig.* 5. It is simply a Spirometer as above, accommodated to the shape of a case.

40. *Directions.*—If by the door behind, we examine the arrangement, we notice a trough for water and a square receiver, with a cord attached to each corner of the receiver, to be passed over respective pullies, to which is attached *one* counterbalance weight, bearing equally upon the four cords. When the counterbalance weight is suspended, the receiver will ascend to the top of the case.

We next pour cold water into the trough or reservoir, filling it to about 2 inches from the top of that vessel; then, as before, pour some coloured spirit into the bent tube C, in front of the case.

In front of the case there is a flexible tube G, which communicates with the receiver in the inside, above this tube will be noticed the handle S, which in its revolution performs *three* offices, according to its position.

Turn the handle towards D as far as it will go and depress the receiver slowly down to the bottom of the vessel; the air is now *discharged*: turn it to S, quite perpendicular, and all communication with the receiver is cut off: turn it towards O, and the tube communicates with the receiver; therefore, into this position O, we move the handle, when a person is breathing into the Spirometer, and after he has breathed his utmost into the receiver, we shut off the communication, by returning the handle to S again.

Therefore, the air is *discharged* at D; communication cut off at S; and the receiver filled at O.

Let us now suppose the Spirometer properly charged with water, and the receiver down at the bottom of the trough, with the handle standing perpendicularly at S. The coloured spirit in the bent tube will not be found level, nor the pointer on the dial exactly at zero, for the reason already assigned (when describing *fig.* 4), viz., that the counterbalance weight is somewhat heavier than the receiver, and draws it up about one-fourth of an inch. Nevertheless the Spirometer is now ready for use.

When an observation is about to be made, we take hold (with our left hand, if the patient is on our left) of the handle, at S, and immediately the person is about to empty his vital capacity into the tube G, (holding the extremity of it between his lips), we immediately turn the handle from S to O, and keep it there until the expiratory volume has been entirely discharged from the lungs, and then we turn the handle back again to S. Now it will be observed that the rod B has risen, that the index on the dial has revolved to a certain figure, and that the coloured spirit is at unequal heights in the two legs of the bent tube C. It is now necessary slightly to depress the rod B *until* the coloured spirit is at equal heights in each leg of the bent tube C, then the index on the dial correctly points to the number of cubic inches of breath discharged into the receiver. To discharge this volume of air, we, with the left hand, *first* (or we shall spill the water in the trough) turn the handle *from* S *to* D, and next with the right hand *slowly* depress the receiver by the rod B down to the bottom of the trough, finally returning the handle to S again. Although this operation appears complicated, yet it is only so in description: when once considered, it is most easily comprehended.

Of the Dial and Pointer.—It will be observed in the inside of the case, that a wire projects from the farthest side of the receiver, turning downwards on the outside of the trough, at the bottom of which is attached a fine cord, with a small counterbalance weight at the end of it; this cord is carried (one turn and a half) over a wood pully, which communicates with the pointer on the face of the dial, but from some accident, probably in carriage, the pointer may not stand at O, on the dial; then we adjust it simply by turning the wooden pully with the hand, allowing the silk cord to slide round the pully, by easing up the small counterbalance weight attached to it, until the pointer does stand at O, remembering that at this time the receiver must be *quite down* at the bottom of the trough.

The graduations on the dial, indicate single cubic inches.

Thermometer.—It will be seen that on the left (*fig.* 5, E) is a small thermometer for noting the general temperature when required.

When the Spirometer is not in use, we take out the rod B,

allowing the receiver to remain up *out* of the water; then close the opening, out of which we took the rod B, by a slide lid on the roof inside, and finally lock the door, when the instrument cannot be deranged either by turning the handle S or blowing into the tube G. This we have found a very necessary arrangement, particularly in public offices.

The water in the trough is renewed by drawing it off with a syphon. There is an arrangement inside for catching the water, should we by accident (an accident by no means uncommon at first) depress the receiver *before* we allow for the escape of the air within, by *not* turning the handle from S to D.

41. If we desire to measure the vital capacity of a patient at his own house, and have not the means of doing so by the Spirometer, we take the three deepest inspirations into an air bag, and measure the whole contents by the Spirometer at home, taking the third of the whole volume as the vital capacity, which will be found very near the truth. Graduated bags have been made for this purpose, but we find them not to correspond with our table of vital capacity, and if our means of admeasurement are not correct, our table of reference is of no use.

42. *For the manufacture of the Spirometer, Air Bag, and Stethoscope, &c.*, see the last page.*

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*For more particulars, See Med. Chur. Trans., vol. 29, art. "Thorax." Cyclopædia of Anat. and Phys., London: Longman and Co. Also art. Respiration, same work. Lancet, July 27th, and Aug. 3rd, 1844, and June 6th, 1846. Med. Times, May 9th, 1846, and Aug. 24th, 1850. Dublin Med. Press, June 24th, 1846. Arch. Geo. de Med., Jan., 1847.

STETHOSCOPE.

43. Although the Stethoscope is in the hands of many persons, yet it is branded with "*uncertainty;*" and the reason we assign for this libel is chiefly because the nomenclature of the sounds is not agreed upon—the crepitation of one, is the rhonchus of another; and hence confusion creeps in, and incorrect diagnosis follows. Nevertheless the Stethoscope will always convey sounds to the ear, whatever be our nomenclature or our diagnosis.

The lungs may be viewed as one large air tube, fimbriated into millions of small tubes: these tubes are for the aëration of the blood, and for the production of voice; consequently there are air sounds and voice sounds.

44. By the same reason that air produces a friction-sound in working the common bellows, so does the air produce certain friction-sounds in the act of respiration.

Air sounds.—From the larynx to the air cell, the tube tapers, and different parts of the tube, have specific names: as larynx, bronchi, capillary tubes, and air cells. As the tube decreases in size, it divides, and multiplies in number. A given volume of air passing down such tapering tube, of necessity produces large and small friction-sounds, according to the size of the tube.

The larger the tube, the larger the sound, and the more *circumscribed* is the region over which it is heard; the smaller the tube, the smaller the sound, and the more *diffused* and extended is the region over which it is heard.

45. *Healthy air sounds.*—A volume of air penetrating the lungs is thence split up into thousands of minute streams, and the larger the volume taken at one draught the more intense the sounds. In children these sounds are more intense than in adults: what is physiological in the former is pathological in the latter. This modification by extreme youth is termed "puerile respiration."

46. In the trachea the sound is large, rough, and hollow; in the bronchi the sound is smaller, and less hollow. In the capillary tubes

and air cells it is termed wiffing and tubular; and in the air cells vesicular, soft and silky—like a breeze among foliage. Therefore there are large and small sounds, corresponding to the size of the tubes over which we listen, and these sounds again are more or less intense, *i.e.*, soft or harsh, according to the quickness of respiration, just as we can modify the air sound in the common bellows, according to the quickness of working them.

The purity of the vesicular murmur increases as we recede from the larger tubes, and therefore it is most characteristic at the lateral and inferior parts of the lungs.

47. Inspiration and expiration are heard in the tracheal and bronchial tubes, but inspiration *only* is heard in the smallest tubes and in the terminal cells; it is inaudible in the smaller tubes, because in *inspiration* the friction of the air against the sides of the tubes is increased as the air penetrates into the increasing number of ramifications, whilst in *expiration* the friction decreases, as the air is gathered up into the larger tubes, in which movement the friction is relatively decreasing; but when the streams arrive at the larger tubes, the friction of expiration is equal to inspiration, and the tubes are so large, that a sound of equal intensity is heard either way.

When the ear approaches the locality of the larger tubes, as nearer the sternum and between the scapulæ, the bronchial sounds considerably masks the vesicular murmer.

48. The volume sounds, for this reason, are larger and harsher over the posterior than over the anterior region—have more of a bronchial character; therefore the ear requires to be specially educated for these two regions.

The expiratory murmer upon the *left* side, below the clavicle, at the acromnial extremity is not heard, but over the corresponding spot on the *right* side, there generally is heard an expiratory murmer, because the distribution of the bronchi is not symmetrical. Where the expiratory murmer is heard, it is not soft, but *harsh*.

49. *Morbid Sounds* are of two kinds:—

a, Volume Sounds, and

b, Secretion Sounds.

50. *Volume Air Sounds.*—These are sounds which affect the

volume of air transmitted through the lungs; however they may be characterised, they are *not* soft and silky sounds.

They are the *earliest* morbid sounds in consumption. They are signs that the relation between the air tubes, and the volume of air is altered; either, that the tubes are absolutely diminished in calibre, or, that a larger volume of air than natural is forced through these channels. As two conditions produce these morbid sounds, (which are not soft and silky,) nevertheless one of them may exist, and *not* be indicative of a morbid lung at that spot, though both of the conditions are signs of morbid action *somewhere* else, for instance, if the *right* lung is densely charged with tubercles, and the *left* lung healthy, the latter has more aïration to perform, and this volume of air being larger than natural for this healthy lung, the sound becomes not soft and silky, but harsh, so here it may be received as supplemental, yet indicative of disease in the opposite lung.

51. Volume morbid sounds may be viewed as produced two ways; generated on the spot, or transmitted from a distance; a constricted tube gives an instance of the first, and a solid lung of the latter kind, transmitting the healthy bronchial sound from a distance, to a locality where it should not be heard.

52. We arrange the volume sounds as follows; however, in doing so, the author begs to acknowledge the very kind and able assistance he has received from his friend and colleague, Dr. Cursham, in this classification.

Volume Sounds.

- Conditions affecting volume.
  - Intensity . . . . . .
    - Strong.
    - Deficient.
    - Absent—Feeble.
  - Rhythm .
    - Time . .
      - Frequent.
      - Quick.
      - Slow.
    - Quality . .
      - Jerking—Wavy.
      - Difficult.
    - Duration .
      - Long.
      - Short.
      - Expiration prolonged.
  - Character . . . . . .
    - Harsh.
    - Bronchial.
    - Cavernous.

53. It is not necessary to remember this list of names, it is easier to bear in mind, that any sound not the soft silky murmer is morbid, and in nine cases out of ten in early phthisis, we find these sounds to be, deficient or harsh with a prolonged expiratory murmer. As ordinary breathing is mostly gentle, we elicit these sounds more distinctly by deep breathing, and request the patient to "breathe deep," the more so, as sometimes a patient will hold his breath whilst we are listening.

54. Some of the characters in the above list can scarcely be looked upon as morbid. Breathing may be feeble from nervousness, but this is recognised by its hesitating, or wavy, interrupted character; not like the quiet feeble breathing of the morbid lung. We do not concur in the opinion that such breathing is indicative of pulmonary consumption.

55. *Long* respirations may be healthy—habit is said to be second nature. We knew a man who breathed only six times in the minute—he once had asthma; it was then he began to breathe thus slowly; his asthma left him, yet his breathing six times in the minute continued. We have known a man when asleep (under the influence of a narcotic) to breathe *twice* in a minute. Slow breathing is scarcely a morbid sign. We knew another man, whose ordinary respirations were *always* 9 per minute, instead of 18 or 20; at 32 years of age he died of consumption. However, every one of these characters may be morbid signs, not of consumption only; for instance, respiration is feeble in emphysema, harsh in bronchitis, difficult in asthma as well as in phthisis pulmonalis; in fact, *any condition* affecting the normal *relation* between the volume of air and the tube to be permiated, may cause these sounds.

56. *Transmitted Sounds.*—We have noticed that large and rough breathing from a bronchus, may be transmitted from a distance: this is an evidence of the deposition of some solid matter, or some better conductor than the ordinary healthy and spungy lung, intervening between the bronchus and the listening ear; by the same reason, the heart's action may be transmitted beyond its region, and this likewise causes a suspicion of pulmonary consolidation. Bronchial breathing may be "*generated*" by an enlarged tube, or by a cavity, as well as transmitted from a distance by morbid matter.

57. *Cavernous Breathing.*—This is a large rough, dry or moist sound, generated in a cavity, and is a sign of such a lesion; but bronchial breathing, is likewise large and rough, and dry or moist, and may be transmitted from a distance, therefore at times there is a difficulty in distinguishing between these two causes, nay, more it may be *impossible* to do so. Young Stethocopists may doubt this—the most difficult part of auscultation is oftentimes to detect a cavity; many men, clever men, and correct men too, have wofully committed themselves upon the question of cavity. We know of no sound which can be considered specific evidence of a cavity; because there is no sound characteristic of a cavity; but that such sound as is commonly attributed to a cavity, is at times absent, when a cavity is present. A cavity varies in size from a millet seed to that of an orange, it may be dry or moist, and it may or may not communicate freely with a bronchial tube. All these phthisical conditions in different combinations, so affect the entrance of air, that the character of any one sound may become modified, so as to leave us in doubt whether such, be a bronchial, transmitted sound, or a cavernous, generated sound. However, it will be borne in mind, that we now only refer to transition conditions, when the lung is *passing* into disorganization; for a large cavity, is tolerably well characterized, yet we may say, scarcely any two cavities give the same characteristics. The vesicular breathing, however, is never to be heard; hence, some morbid condition of lung must exist, either solid or cavernous.

58. *Secretion Sounds.*—As tubercular matter is first crude and then soft, and as the mucous membrane in pulmonary consumption is always more or less in a state of inflammation, there are sounds generated, peculiar to these conditions, giving to the ear the impression of morbid secretion, known as crackles and crepitations; these likewise correspond with the size of the air tubes, causing large and small sounds. The volume sounds are all dry sounds—these are not all so; they may be divided into two kinds, dry and moist. Some persons object to the word *dry* sound, because they say, how can there be a dry sound in a moist chest? Who objects to the expression "*Metallic tinkle*"? and yet there is no metal in the chest.

The impression given, need have no actual relation to the conditions producing it, more than theatrical thunder to thunder in the firmament.

59.—Secretion Sounds.

- Sounds caused by morbid Secretion.
  - Dry Sounds
    - Sibilus, in small tubes.
    - Rhonchus, in large tubes.
    - Dry Crackle,—crude tubercle.
  - Moist Sounds
    - Fine Crepitation,—Pneumonia.
    - Small ditto,—Capillary bronchi.
    - Large ditto.—Bronchitis—cavernous gargle.
    - Humid Crackle,—softened tubercles

There are here given seven sounds, yet, they resolve themselves into only *three* sounds of different characters.

60. First.—Sibilus and Rhonchus are the same sounds, only modified in size.

Sibilus is a hissing, or wheezing sound, and is produced in the capillary tubes or air cells.

Rhonchus is a snoring, or droning hum, at times like the cooing of a pigeon; it is merely a large "sibilus" in the bronchi.

They are both indications of diminished air tube. Rhonchus is of less pathological importance than sibilus, because in the latter, whatever be the morbid action generating this sound, such is nearer the air cells. The cause of these sounds is somewhat obscure, probably a thickened membrane with more mucous than natural. These are not specific signs of consumption, for they attend bronchitis, cattarrh, and asthma.

66. Second.—*Crepitation* is a moist sound, of three kinds, according to the size of the tubes in which it is generated. This sound gives the impression of the bursting of bubbles, well illustrated, by the bursting of the fine bubbles in a glass of "*fresh ale*" just after it has been poured out of the bottle, and the fine crepitation is like the rubbing of a lock of hair over the ear between the fingers and thumb.

These are *sure* signs of inflammation or pneumonia in the specific

parts generated, whether in the large or small tubes. When in the large tubes, we say there is bronchitis, and when in the parenchyma lung, pneumonia.

These bubble sounds are very characteristic and cannot well be confounded with those other chest sounds, which we next notice.

If Laennec had done no more in his short space of time, than discover this crepitating sound, and the pathology thereof, Laennec had erected for himself a monument, more durable than any now standing, on the plains of Egypt.

62. Third.—*Crackles.*

The Dry.—This does not give the impression of the bursting of bubbles, therefore it is *not crepitation;* it resembles the sound produced by crumpling up in the hand very fine tissue paper; it is stationary and not so easily moved out of hearing by a cough, as are commonly the mucous sounds in cattarrh, bronchitis, &c. It may be very circumscribed or diffused; by degrees it glides into the moist crackle, and hence in a certain stage of transition, it is difficult to distinguish from the humid crackle. It is at this point, that many long names are well sprinkled into Stethoscopic nomenclature, but not comprehending those terms, we are forced to omit them.

63. *The Moist.*—This gives the impression of the bursting of a small viscid bubble, beautifully illustrated by that "*liquid click,*" often heard when an "old pipe" is nearly smoked out; this likewise is stationary or fixed, and not easily removed by a cough. The dry and moist crackles may exist together, and one mask the other; they may be circumscribed or diffused according to the extent of disease in the lungs.

64. These crackles may be heard an innumerable number of times in inspiration only, or in expiration only, or in both inspiration and expiration, or there may be only one crackle in each of these acts, or one crackle or click in 10 or 15 respirations; but one "click" is enough, the patient has phthisis pulmonalis, for they are specific signs of disease, the dry of crude, and the moist of softened tubercles.

65. Although tubercles may exist without these crackles, yet these crackles cannot exist without tubercles.

All the foregoing are breathing sounds, but there are certain other sounds of a pathological character, caused by the voice.

Voice Sounds.

Voice . . . . . { Tracheophony or Pectoriloquy. Bronchophony. Resonance.

66. These are merely sounds of degree; large, small, smallest, according to the respective size of the air tubes, to which the sound has penetrated. They are merely expiratory sounds directed from the larynx outwards; the voice being generated in the trachea, it is here most distinct, and termed "tracheophony or pectoriloquy." As the voice descends backwards into the lungs, it is less distinct, where the air tubes are smaller, as in the bronchi, where it is termed "bronchophony;" further down into the lungs, the sound becomes more indistinct, so that in the capillary tubes and cells, we have only a faint resonance; therefore, these sounds glide into each other, strong resonance is weak bronchophony, and strong bronchophony is weak tracheophony.

As the ear passes from the sides and bottom of the chest, towards the sternum, and up to the larynx, we pass through these gradations of sound; posteriorly bronchophony is more extensive, particularly between the scapulæ, because the ear is nearer the larger air tubes. These are all HEALTHY sounds IN their respective parts.

67. As phthisis first increases the density of the lungs, and disintegrates them into cavities of different magnitudes, the conduction of these vocal sounds is modified, and they become transmitted to distant parts; or where a cavity is formed, the large vocal sound is not broken up; thus they become transmitted to other localities, not natural, and are morbid signs. If we hear the tracheal sounds where we should hear the bronchial sound, or the bronchial sound where we should only hear a slight vocal resonance, then we have evidence of the presence of some better conductor of sound, than the natural spongy texture of the lung, as air, fluids, or solids; and we then speak of these sounds as morbid signs, and say, there

is pectoriloquy or bronchophony. A cavity according to the freedom of its communication through the larger air tubes with the trachea where the voice is generated, gives the tracheal sound or pectoriloquy, but this depends upon the freedom of such communication. A very solid state of lung will also communicate the voice from the trachea, and give the same impression as if a cavity were present, therefore, voice sounds are more uncertain signs of a specific condition of the lungs, than are the crackles and crepitation of tubercles, or pneumonia.

68. The vocal sounds on the right and left sides of the chest, like the expiratory murmer, (48) are not alike at corresponding points.

Below the acromial extremity of the clavicles, we have this natural difference; on the *right* side there is a vocal resonance, and on the left there is *none*, therefore; vocal resonance on the left side is *morbid*, and often an early sign of consumption.

69. For the most part the vocal (which are always transmitted sounds) are an evidence of the increased density of the lung. They may be circumscribed or diffused, according to the extent of lung disease; when pectoriloquy is very circumscribed, it becomes a more definite sign of cavity.

70. There are other morbid lung sounds, as metallic tinkling, amphoric breathing, œgophony, &c., which we pass over; they are rare sounds in the latter stage of disease, and known when once heard; demanding no peculiar treatment; they are all signs of *serious* disease, as cavities or fluid in the chest. What we have noticed will probably enable us to come to the great point, Is disease present? Has disease begun? What have we to expect? we would rather know the first sign of phthisis than the second, and the second than the third, and, therefore, we have noticed such sounds as are present among the first symptoms of consumption.

71. *Epitomy of the Morbid Sounds.*

These sounds are of two kinds, volume and secretion sounds.

Volume sounds may be generated where heard, or transmitted to that point, the chief are, deficient, feeble, harsh, bronchial or cavernous, expiration prolonged and harsh.

Secretion sounds are of two kinds, *dry and moist.*

Dry—Rhonchus—Sibilus—Crackle.

Moist—Crepitation—Crackle.

Volume sounds come first as a sign of phthisis, then follow secretion sounds.

To distinguish the two crackles, the dry from the moist, is most difficult.

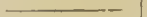
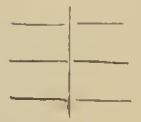
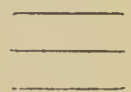
The difference between crepitation and crackle is broadly marked.

The "*crackles*" are a specific sign of consumption; they may be heard once or many times in one respiration; they are fixed sounds, and not easily removed by coughing; they may remain, particularly the dry crackle, for months, gradually creeping onwards into more advanced conditions, until we have the cavernous gurgle.

72. At the Hospital for consumption, where we examine from 70 to 100 cases in one visit, we find it convenient to put an outline of the case on the top of each patient's paper, and that in a manner as *brief* as possible, and in a form which can be read at a glance, read indeed, while we are asking the patient a question.

73. To obtain this we select the chief morbid conditions, as MOBILITY of the chest in breathing, limited or non-symmetrical; PERCUSSION; and under respiration, HARSH; DEFICIENT; EXPIRATION audible and prolonged; under voice, RESONANCE; under secretion sounds; DRY CRACKLE, HUMID CRACKLE, CAVITY; and lastly, the HEIGHT, WEIGHT, and VITAL CAPACITY. Chiefly the initials, of these words are arranged in a tabular form, and if the affection is on the *right* side, we make a perpendicular mark, thus | , and if on the left side, we make a horizontal mark, thus —, and according to the severity of the morbid condition, we increase the number of strokes from one to three. Thus under the word resonance, one stroke is resonance, two strokes, stronger resonance or bronchophony, and three strokes pectoriloquy. In this way the history of the case is read in a moment. For example, let us suppose that we examine three cases, male or female, in different stages in consumption, after the manner described, first trying their breathing mobility, (14) then the percussion; next the volume sounds; the voice, and lastly the secretion sounds. Noting these cases in a tabular form, they would appear as on the following page.

IV.—TABULAR EXPRESSION OF CASES.

CASES.	RESPIRATION.					VOICE.	SECRETION SOUNDS.					
Males.	M.	P.	H.	D.	Exp.	Res.	$\frac{D}{C}$	$\frac{H}{C}$	C	Height.	Weight.	V.C.
A										Ft. In. 5 8	lbs. 110	140
B										5 8	100	115
C.		?								5 8	140	200

M. Mobility.
P. Percussion.
H. Harsh Respiration.
D. Deficient Respiration.
Exp. Expiration Rough.
Res. Resonance.
$\frac{D}{C}$ Dry Crackle.
$\frac{H}{C}$ Humid Crackle.
C. Cavity.
V.C. Vital Capacity.
| Right side.
— Left side.

The history of patient A reads thus:—breathing movement diminished on the right and left; respiration harsh on the left; expiration prolonged and rough on the right; with resonance of the voice on the right, &c.

Patient B is a worse case; the breathing movements are non-symmetrical, less on the left; percussion very dull on the left, and slightly so on the right; respiration is harsh on the right and left, and very deficient on the left; expiration prolonged on the left; there is also pectoriloquy on the left, indicated by the *three* strokes; and resonance of voice on the right; likewise, dry and humid crackle on the left with a cavity also on the left.

Patient C is in a much better condition; percussion is doubtful on the right, with deficient breathing on the left.

In this way, by a few marks, we read the case, and these initials generally supply all our enquiries; but if other conditions are present, we note them by a single word below. The above table says nothing about the region of the chest; if any of the morbid signs are posteriorly, we mark a small p at the end of the sign, thus — p, or one line may be given to anterior and another to posterior observations.

74. In phthisis, stethoscopic signs, to our mind, stand last as evidence of that disease, only presented when the complaint has began to localize itself in the lungs, for in truth consumption is not disease of the lungs, any more than gout is disease of the great toe—gout manifests itself in the toe as phthisis does in the lungs. The *first* sign of consumption is *loss of weight*, and if the patient has not lost weight, we have as yet NO EVIDENCE of the disease in question having commenced. The second sign, is diminished vital capacity, with a stooping form of the chest; and thirdly the morbid "*volume sounds*" in respiration as stethoscopic signs.*

The Stethoscope we use, is described par. 150.

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*For the author's tabular view of the Symptoms of Consumption, see *Med. Times*, Sep. 7th, 1850, p. 253, or Dr. Rankings' *Half-Yearly Abstract of Medical Science*, vol. 12, 1850, p. 43.

TO THE MEDICAL REFEREES

OF

LIFE ASSURANCE OFFICES

FOR HEALTHY LIVES.

75. The knowledge required by a medical man in the "life office" and in the private consulting room is very different. In the consulting room, the patient is full of complaints, ready to acknowledge all the symptoms of disease which he may experience; but in the assurance office, generally, the applicant acknowledges no complaint, he wishes to appear free from all diseases; in the consulting room, no information is withheld; in the life office, the tendency is to withhold, or keep back certain information; and here it is for the medical officer to sift out, and detect the existence of any condition which may tend to shorten life. We have, therefore, to look for hidden diseases or conditions which may threaten to shorten life; and, also, to consider, if any previous illness has left such traces, as may, by the common exposures of life, be expected to cause death.

76. It is now the custom in life offices, to furnish a printed form of questions, to be filled up by their medical officer. Questions are all important, and questions must be asked of the applicant, but too often there is a long and needless list given to the medical officer. We have seen such a paper contain 101 questions, terminating with another demand of the referees "private impression" of "any thing else to be suspected, &c."

77. This is injurious to an office; no man likes to answer a number of personal questions; moreover, the manner in which they are answered, particularly by writing, is generally cursory and

vague; the office in reality is not more safely guided by this mass of questions.

78. An assurance office should rest upon the judgment of their medical man, and not upon the long printed list of questions: if the former cannot be depended upon, neither may the latter. An applicant for assurance visits an office, and it is for the medical officer to sift out in the most delicate manner, is this a "good life," or is it not so?

79. Let our printed questions be few—to the point, and let each one be well considered; indeed, we are disposed to think, that they may all resolve themselves into

1. What is the family history?
2. What are the habits of life?
3. What is the height and weight?
4. What illnesses since childhood?

These few questions when well examined, and judiciously considered in *all* their bearings, are sufficient for the protection of a life office.

80. Family History.—It is well known, that certain diseases are transmitted from parents to children, as consumption, insanity, scrofula, gout, gravel, and probably, apoplexy, and general habits. Of these diseases, we shall chiefly notice consumption, insanity, and apoplexy, from their fatal, insidious, and sudden character, they are much to be dreaded by a life office.

81. All mankind is liable to these diseases, but a peculiar liability is induced by the transmission of something, yet unknown, to the child from the parents. And what is more remarkable, this *something,* which transmits the parents' disease, may be dormant in the child, and spring up in the grandchild. Nevertheless, by "Family history," we extend our enquiries only to father, mother, brothers, and sisters. Every child born of parents afflicted with the diseases in question, has a peculiar readiness to fall into these particular diseases, when their system is duly irritated, but the same irritation will not produce these diseases in children born of healthy parents; therefore, the healthy condition of the parents, becomes of *great value,* in calculating the future life of the child.

82. We shall show a few facts of the liability to certain diseases from the parents.

TABLE V.—Hereditary Consumption in 1339 Consumptive Cases, (distinct families), gathered at the Hospital for Consumption, Brompton.

Sex.	No. of Cases.	Transmitted by Parents.	Per Cent.
Males . .	874	154	17.62
Females .	465	159	34.19
Total . .	1339	313	23·37

This reads that out of 874 males who had consumption, 154 or 17.62 per cent of them, had lost one of their male offspring.

TABLE VI.—Hereditary Consumption.—showing the relation of the transmitting power by the male and female parents respectively, to their children, in the above 313 Consumptive Patients.

FAMILY.	Male	Female	PER CENT Male.	PER CENT Female
Father	60	46	38.96	28.93
Mother	30	52	19.48	32.70
Father and mother	12	11	7.77	6.91
Father, and brother or sister	26	19	16.88	11.94
Mother, and brother or sister	22	24	14.28	15.09
Father and mother, and brother or sister	4	7	2.59	4.40
	154	159	16.66	16.66

This reads as follows:—out of 154 males, (who manifested consumption) 60 of them, or 38.96 per cent. lost their fathers by the same disease; and out of 159 females who manifested consumption, 46 of them, or 28.93 per cent. also lost their fathers by the same disease. It must be understood, that these are distinct families, and not two cases out of the same family, thus, the 154 males had 154 fathers and 154 mothers, &c.

83. Besides the above 1339 cases, there were 16 other cases of consumption, appearing in the brothers or sisters only, of the same families.

TABLE VII.—Showing out of 318 Consumptive Patients, of distinct families, in how many cases the same diseases existed in their brothers or sisters, and not in the parents.

	Cases.	Brother.	Sister.	Brother & Sister.	Total.	Per cent.
Males . .	189	3	2	6	11	5.82
Females .	129	1	1	3	5	3.87
Total . .	318	4	3	9	16	5.03

The table reads thus:—three consumptive females, or 3.87 per cent. out of 129 consumptive females, had lost one or more *brothers and sisters* by the same disease.

84. By Table V., we learn that consumption so commonly appears in the child of the consumptive parent, that out of 1339 fathers and mothers, 313 children manifested the same disease, or nearly one quarter (23.37) become consumptive by hereditary descent. Moreover, that the males apparently resisted this hereditary tendency with greater vigour than the females, nearly as 2 to 1, or that females are sooner excited to have the disease than males, as 34 is to 17. Taking both sexes, it may be received, that

liability to consumption, from the parents who have consumption, is 1 in 4. Taking the general mortality in England for 1847, by the Registrar General's returns at 420,977; the deaths by phthisis is 53,317; or, nearly 1 in 8 (7.8) of the whole deaths, is by consumption, or 12.66 per cent. Deducting even this 12.66 per cent. as the liability to death by consumption, above all other causes of death, there still remains an excess of 10.71 per cent. (nearly double) increase by hereditary taint. In this country, the liability to consumption is greater in females than males, as 28,234 is to 25,083. In Table V., the liability of females being more than double that of males, relates only to the cases admitted at that Hospital; this great difference may be accounted for, by the probability of females knowing more of their family history than males, and thence, they sooner present themselves than males; and, again, males seldom come for advice, until they are forced by illness to do so. However, we may safely receive the opinion, that when consumption is in the father or mother, liability in the children is 25 per cent.; or, if 100 parents have consumption, and each parent has one child, 25 of them may be expected to manifest the same disease.

85. By Table VI., we notice the disease in question, as transmitted to the different sexes, by the male and female parent, and the result is, that the father transmits most to the male child, and the mother most to the female child, and the contrary, viz.:—that the father transmits less to the female children than the mother, and the mother less to the male children than the father; or, they possess about the same power to transmit this disease to the offspring of their own sex. This is very striking and may be depended upon.

86. The low per centage of transmission when both father and mother are consumptive, is most probably here accounted for, by their offspring perishing of consumption in infancy, and this Hospital is more for adults, than infants; at least, few infant patients are presented for admission. By one of the Registrar General's returns, the mortality by consumption, in the first 4 years, is $\frac{1}{10}$ of

the total number, of those who die of this disease, throughout the whole period of life. The rest of the combinations in this table, (VI) seem to be influenced peculiarly by the male or female parents transmitting the disease in question, to the children of their own sex.

By Table VII., we see 5 per cent., or 1 in 20 manifest consumption, when it has only appeared in their brothers or sisters.

87. We next notice the age at which consumption appears; as a general rule, it is a disease of youth, though it may appear at any time, from 1 to 70 years of age. The following table is quoted from the report of the Brompton Hospital, (p. 9).

TABLE VIII.—The Presence of Consumption in relation to age, in 4358 Living Cases.

Age.	Male.	Per cent	Female	Per cent	Total	Per cent.
0 to 5	9	0.33	12	0.71	21	0.48
5 — 15	125	4.66	112	6.67	237	5.43
15 — 25	695	25.94	574	34.19	1269	29.11
25 — 35	953	35.50	578	34.42	1531	35.13
35 — 45	570	21.27	271	16.14	841	19.29
45 — 55	251	9.37	110	6.55	361	8.28
55 — 65	68	2.53	21	1.25	89	2.04
65 — 75	8	0.29	1	0.05	9	0.20
Total.....	2679	.....	1679	.....	4358	

88. From this it appears, that out of 4358 cases, 3641 or 83.54 per cent., gave signs of consumption, between the ages of 15 and 45. We should from our own experience, independently of regular statistics, have come to a similar conclusion. Allowing the economy attending an hospital to influence the admission of cases at certain ages, still the effect is too strongly marked to admit of doubt, to show the period of adult life, which is most vulnerable to consumption. Perhaps it may be noticed, that females sooner present the disease in question, than the males, though they closely correspond in the above table, at the ages of 25 to 35 years.

TABLE IX.—Hereditary Insanity.—3175 Cases.*

No of Csses.		Hereditary predispositiou		Per cent.	
Male.	Female.	Male.	Female.	Male.	Female.
1045	2130	366	741	35·02	34·78

The above table reads thus:—1045 males transmitted insanity to 366 sons, in proportion of 35.62.

89. Taking the hereditary descent of consumption at 25 per cent., insanity may be taken at 35 per cent.! There is reason to think, that this is considerably within the truth, from the tendency amongst persons, to keep secret the presence of such disease existing in their family; and, when we do extract any information on this head, it is at most, but the acknowledgment of a "slight nervous condition," or, of one somewhat "eccentric at times." Nothing demonstrates more clearly, the great hereditary power of insanity, than the difficulty of eliciting the truth of such affections, existing in their families. It is considered, that the liability in some cases by hereditary predisposition, is even so high as 51 per cent.†

90. *Mortality of Consumption, Apoplexy, and Insanity, in relation to age.*—If man is more liable at certain ages to certain diseases, it follows that he is more liable to death at certain ages. The combination alone of *death* and *age* is not sufficient to determine at what age man is most liable to die from a certain disease. The chances of mortality should be viewed also relatively to the numbers living. For example, let us illustrate this by a financial question:—Suppose we have to determine the waste of money of a man's income for one year, at each month, who has only £500 of capital with no means of ever obtaining another shilling, the knowledge of the actual money expended in each month would not answer the

*From Statistics of Insanity, by Dr. Thurnam, and Art. "Insanity," *Dic. of Med.*, by Dr. Copeland.

† Statistics of Insanity, by Dr. Thurnam, p. 77.

question of this monthly waste of capital: we must likewise know his assets in hand; for £50 spent in June may be relatively less than £15 spent in November; because in June there may be £200 in hand, while in November there may only be £20 in hand; hence the expenditure is relatively greater in November than in June, though in this latter month his expenditure was *actually* greater. Just so, in the question of mortality, the liability to the waste of life at any particular period, is measureable by the numbers living; the absolute deaths, only being one of the necessary elements in the calculation.

Addison thus pleasingly illustrates the span of human life, across the tide of eternity, in his vision of Mirza, by a bridge over a river, a way beset with concealed trap doors; found thick at the entrance, growing scarcer towards the middle, and laying closer together towards the extremity. The chances of death at any particular arch by these pit falls, being estimated from the numbers that escape.

91. The number of absolute deaths from consumption in England, according to the Registrar-General's Returns for 1847, is greatest between the ages of 20 and 30 years; but when viewed relatively to the numbers living, (and hence the chances of escape), it places the highest mortality at a more advanced period, viz., between 40 and 50 years of age.

92. Let us view the mortality from consumption and apoplexy relatively to 100,000 souls living, *i. e.*, suppose this crowd ushered into the world at one given time, in the space of 90 years, how many out of this number die, at 12 periods in the 90 years?

93. The numbers living we suppose to be 100,000; of these 51,023 are males, and 48,977 are females, this being the proportion determined by calculation in the life table.*

94. The deaths in the following table, are calculated from the actual mortality at the time,† corrected by (the life table) a table‡ of

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*Fifth Annual Report, Registrar General's returns, p. 48.

†Ibb. p. 288, et seq.

‡Those who wish to consider this subject of mortality relative to age, should consult the 5th Annual Report already mentioned, and see Mr. Farr's able observations upon this branch of statistics.

the probable "duration of life." In this way the mortality from the diseases in question, appears as follows:—

CONSUMPTION.

TABLE X.—Showing the Deaths by Consumption, at 12 Periods of Life, out of 51,023 Males, and 48,977 Females Living, equal 100,000.

Years. Age.	Mortality by Consumption.		Per cent. dying by Consumption, to the living.		Living.	
	Male	Female.	Male.	Female.	Male.	Female.
0 and under 5	967	920	1.87	1.87	51023	48977
5 — 10	232	248	0.67	0.73	34358	33971
10 — 15	148	194	0.45	0.60	32623	32298
15 — 20	406	380	1.27	1.21	31904	31636
20 — 30	1438	1036	4.65	3.36	30878	30806
30 — 40	1498	1360	5.33	4.76	28099	28569
40 — 50	1611	1113	6.59	4.38	24443	25409
50 — 60	1321	815	6.72	3.76	19635	21674
60 — 70	576	455	4.25	2.88	13539	16300
70 — 80	88	116	1.26	1.23	6973	9371
80 — 90	12	5	0.66	0.18	1779	2723
90 and upwards	0	0	0.00	0.00	134	226
Total.....	8297	6642				

The table reads thus:—28099 males are living at 30 years of age, and out of these, 1498 die of consumption in the next ten years, or 5.33 per cent.

APOPLEXY.

TABLE XI.—Showing the Deaths by Apoplexy at 12 Periods of Life, out of 51,023 Males, and 48,977 Females Living, equal 100,000.

	Mortality by Apoplexy.		Per cent dying by Apoplexy, to the living.		Living.	
	Male.	Female.	Male.	Female.	Male.	Female.
0 and under 5	31	43	0.06	0.08	51023	48977
5 — 10	9	9	0.02	0.02	34358	33971
10 — 15	4	2	0.01	0.00	32623	32298
15 — 20	2	7	0.00	0.02	31904	31636
20 — 30	19	20	0.06	0.06	30878	30806
30 — 40	73	55	0.25	0.19	28099	28569
40 — 50	142	119	0.58	0.47	24443	25409
50 — 60	295	265	1.50	1.22	19635	21674
60 — 70	308	333	2.27	2.04	13539	16300
70 — 80	265	253	3.80	2.69	6973	9371
80 — 90	46	54	2.58	1.94	1779	2723
90 and upwards	4	5	2.98	1.90	134	226
Total.....	1198	1165	.			

This reads the same as the last table, viz., 21,674 females are living at 50 years of age, and 265 of these die of apoplexy in the next ten years, or 1.22 per cent.

95. From these tables, consumption in males is most fatal between the ages of 20 and about 55; in females, between 20 and 35. Apoplexy is most common at a more advanced age, from 40 to 90, in both sexes.

96. *Effect of Insanity.*—It has been said, that insanity does *not* shorten life; there never was a greater error. So recently as 1835* the solicitors of the deceased Revd. Mr. Frank, gained a verdict of £2000 from the Provident Assurance Office, on the ground of insanity *not* having "a tendency to shorten life." Mr. Farr has shown, that the mortality out of 100 living lunatics, is 9.02 per cent., while the deaths of the general population of European nations, amount to about 1.50 per cent. "*Madness, therefore, increases the mortality six-fold.*"† Insanity, like consumption, shows itself in the early part of life, seldom before the age of 15, but, at from 20 to 50 years of age. Also, like consumption, there is an excess on the side of females of 4 per cent.,‡ and, of nearly 12 per cent. in a distinct class of cases—paupers.

97. To sum up, we have shown that consumption is hereditary in about 25 per cent.; that each parent transmits this disease above 30 per cent., to the children of their own sex. When it presents itself in a family, independently of the parents, the liability of the whole family of children, is 5 per cent.; that the period most liable to its attacks, is between the ages of 15 and 45, or, out of 100 attacks, 83.54 would be between these ages. By insanity, 35 per cent. are afflicted from hereditary descent.

98. *In regard to Mortality.*—That consumption cuts off life in men, between 20 and 55, and in females, between 20 and 35 years of age; that apoplexy is most common between 40 and 90 years of age; and that insanity shortens life *six-fold,* between the age of 20 and 50 years.

99. *Deductions.*—We wish it to be borne in mind, that we only venture to give some general rules upon rejecting lives, because it

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*Vide Statistics of Lunatic Asylums, by Mr. Farr, p. 11.

†Ibb., p. 12.

‡Dr. Thurnam's Statistics of Insanity, p. 148.

is not possible to notice all the innumerable combinations of circumstances, which present themselves in a life office, relative to the eligibility of a life for assurance.

100. First.—*What is the Family History?*

What is the health of the parents? if dead, of what disease did they die? The applicant for assurance may say, "I do not exactly know;" then we should endeavour to obtain negative evidence that they were not consumptive, nor insane, nor apoplectic. Paucity of evidence upon the family history, must be made up by strictness on the part of the medical officer; as to the healthliness of the applicant, in connection with age and sex, whether within or without the obnoxious period of any hereditary disease.

101. If instead of the person appearing before the medical officer, the only information to be derived is by letter, and we find family history imperfect, or if any other question arises in our mind that the life is not eligible, we should communicate with the country referee, and make him pledge himself that there is no danger of consumption, or apoplexy, or insanity, &c., then, should the "life fall in," we can refer back to this written opinion with more satisfaction, for then, any charge of medical laxity, does not rest with the medical officer, who has not seen the case. If the referee will not positively pledge himself, and we still have doubts remaining, we decline the case. Let us suppose the present applicant of the middle period of life, and that consumption is in the parents, father and mother, father or mother; then we *decline* the case, nevertheless, he may live a long life; this matters not, for if we accept such, we may accept another and another; when most assuredly the office will ultimately suffer loss, for there is at least, 1 additional chance in 4 against the office, even if the sex of the applicant and the consumptive parent be not the same; and about 1 chance in 3 against the office, if they are of the same sex. We must remember that he *is* predisposed, *i. e.*, a something is latent in him, ready to appear, as consumption, and his chances of escape consist in the question of his system not being irritated by some condition in life to bring this forth, and not the chances that he may "catch consumption," for he has caught it; but by his *vigour*

it remains latent for a time, until the proper irritant comes, then, in popular language, we say, "he has got consumption," when in truth, it has only been roused to appear.

102. When consumption is in the parents, are there any exceptions to this rule? There may be so, but they are rare. Suppose the applicant to be a healthy man, of 35 or 40 years of age, and wanting, perhaps, an assurance for a limited time: if he was born many years before his parent's death, and the children after him are all healthy, it would be difficult to decline him, particularly if there was no consumption in the grand parents. At the same time, the applicants present *health* and *habits, must be unexceptionable;* however, as a general rule, the offspring of consumptive parents should not be taken at the ordinary rate, and, *in all cases we should decline* if the parent died shortly after the birth of the applicant. So rare is this exception, to the general rule first laid down, that we have only accepted one case (and that for a limited period of 7 years in a man aged 35) through the period of some years practice in an office, where an extensive business is conducted.

103. If the parents are well, but one, two, or three of the children have died of consumption, shall we accept, or, decline the applicant? This will depend upon circumstances. Consumption may be generated in one or more members of the family, by some undue excess, by dissipation, or by child-bearing, or grief, &c., yet if the applicant be *healthy* and of good habits, we may accept him; but if 4 or 5 children have died of consumption, it begins to look as though it were hereditary from grand-parents, and the age of the applicant becomes important to consider. For instance, if he be about the age of the deceased children, we should be disposed to decline the case, or if he shows the least flaw, such as decreasing in weight (Table XII) or vital capacity, (Table I); whatever be the appearance of the applicant, we should still decline the case, but, if he be older than the deceased children, say about 40 years of age, with an unexceptionable appearance, and other static conditions good, we should be inclined to accept such a life.

104. If the applicant has lost one brother or sister by consumption, particularly where it is thought to have been induced by some act

on the part of the deceased, we think, such fact weighs very little against the other children of the family, at least, we have never yet rejected a case on this ground.

105. There are many combinations of circumstances in this question, which it is impossible to enter upon, but in cases of doubt, when things seem to be about equally balanced, it is sometimes of use to ask ourselves, should we like 100 such cases on the books? By exaggerating a condition, we often come to a correct bias. The mind *per se*, is weak in judgment, *i. e.* it may be drawn either way, according to our tastes; for instance, put a £10,000 prize, amongst 1000 blanks, allow us one draw, should we not feel the chances were so many against us, that we should *sell* our chance for £50? But, substitute a death-warrant for the £10,000 prize, should we not be tempted to *give* £50 to be saved the chance of drawing the death-warrant? yet the chances in both instances are exactly the same, but we cannot feel, or see it so.

106. To return to our subject; the first sign of consumption is loss of weight, and if there is consumption in the parent, and the applicant has steadily lost weight, for the last 5 or 6 months, without *one exception*, we should decline such a life. If a man has had hæmoptysis we should decline him; a woman, particularly under 25 years of age, may have had hæmoptysis, and yet be a safe case for assurance. (Par. 146).

107, *Apoplexy.*—This cause of death is most fatal in advanced life. Happily, it is comparatively a rare disease, but it comes on with silent steps, oftentimes smites without warning, and with one stroke the spark of life is extinguished! Man is subject to it between 40 and 90 years of age; even one quarter of the deaths by apoplexy occur, between 60 and 70 years of age, therefore, a suspected case wades deeper and deeper with advancing years, into the chances of this disease. Men are more subject to this disease than women.

108. We believe apoplexy to be as common in those who are thin and tall, as in those who are short and stout. If the applicant is considerably above the mean weight, (Table XII) and has suddenly become so, *i. e.*, within 4 or 6 years, we should decline the case, for if a person is rapidly making fat, he may convert other tissues into fat, and the blood vessels may lose their tone, and apoplexy ensue.

109. We knew a young man æt. 30, who had a small discharging sore on his foot, caused by a carriage running over it, some 20 years before; in other respects he was perfectly healthy, and born of healthy parents; one of 10 children, all well, and in robust health; he was assured, with a trifling addition, for the wound mentioned, which became so small that it healed; he then improved in appearance, gained two stone or 28lbs. in weight; at the age of 35 he appeared what is termed, a fine, stout, active man, unexceptionable to all appearance, a life, that any office would accept; by occupation he was an accountant—one morning he was found *dead at his desk*. This man was only the average weight before. But he was thin; yet he never became the short stout man, or the apoplectic man in appearance; however, apoplexy killed him, and the life office *paid* £1000 to his wife, (120).

110. *Of Insanity* we have had little experience; it is hereditary in at least 35 per cent of the cases, (Table IX, p. 44); therefore, we may dread it more than we do consumption. In other respects, it is much more rare than consumption, as 543 to 53,317, or as 1 to 98. Insanity *shortens life "six-fold."* However, insanity may be excited by drinking or by mental distress, and in this case, where we think it is so induced, it is natural to look upon the child as out of the pale of hereditary predisposition, the more so, if the disease manifests itself many years after the birth of the applicant; in this way, cases might be accepted as *eligible*, we being satisfied that the same circumstances of excitement are not likely to befal the applicant.

111. In other respects, when insanity is in either parent, and cannot be accounted for by any depressing circumstances in life, and the applicant is under 40 years of age, we should be disposed to decline the "*risk*," particularly if his circumstances are not good, for he has the predisposition, and only wants one, among many exciting causes, to make the same disease manifest.

112. Second.—*What are the Habits of life.*—This is of the next importance, how does the applicant live? A person that "*drinks*," must under all circumstances be *declined*, even after a reformation of 3 or 4 years. "Drinking" is differently expressed; it is some-

times called, "*taking a drop*," or it is said, that he enjoys "*a single* glass of grog;" if any such information oozes out, we may feel sure that the applicant takes more than a "*drop, or a single glass of grog*;" nothing short of the direct word "SOBER" will do, or we must decline the case. Out of 24 causes of insanity, in 1375 cases, 136, or nearly 10 per cent (9.8) become so by the "abuse of spirituous liquors."* The word *regular* under this head, is sometimes of little value: a man once told us that he was "*most regular*," and it subsequently appeared he was *most regularly* intoxicated every day, for 20 years. A sober man is *saved from* a multitude of dangers to life, and on the other hand, a drinking man is *exposed to* a multitude of dangers to life. A drinking man, is a worse life than a madman for assurance. Drinking leads to domestic distress, and out of the above 1375 cases quoted, domestic distress led 278, or 20 per cent. to madness. Reformations are rare.

113. We do not even like a case where the parents have been drunkards, there is reason to think, that "habits of life" are hereditary.

A stout man, or a thin young man who "enjoys the pleasures of the table," is a bad life, for this leads to wine, and wine leads not to prolonging our days.

114. All excesses wear life too quickly; anything *short* of being *sober*, keeping *early* hours, and being active, are dangerous lives to assure.

Out of the above 1375 cases of insanity there were from

		Insane
Exciting causes	Excesses of all kinds . . .	198
	Drinking	136
	Domestic distress	278
	Reverses of fortune & gambling	54
	Total	666

115. therefore nearly 50 per cent. of these human beings were in a madhouse, from causes which come under "*Habits of Life*."

116. There is something about a sober man, not often to

**Dic. Prac. Med.*, by J. Copeland, M.D., Art. "Insanity," p. 495.

be mistaken; he writes his name, if under 60 years of age, with a *steady hand*, and he is regular in his house. We have known a man described as *perfectly sober*, æt. 44, but who signed his name all zigzag; this he was prepared to swear was constitutional; however upon enquiry, it was found he was in the habit of exceeding. Had this man not signed his name, most certainly he would have been accepted, for he actually deceived one of the most experienced and able physicians, by offering to take a "*solemn oath*" that his unsteady hand was mere nervousness.

117. In the common transactions of life, strong protestations and solemn oaths appear to us weaker than a simple yea or nay.

Tavern keepers in a small way, though not drunkards, are apt to "sip too often," and ultimately become corpulent, particularly women in this line of business; if we accept such lives, we cannot be *too* strict in examining into their general habits. If they are of excess weight, *i. e.* corpulent, we would decline them, for the cup is ever in their hand; and if temptation and opportunity meet, where are the best of us in such circumstances?

118. Drinking, or desire for it, is more common than may be suspected; many are its victims that know not they are so—they speak lightly of having "made free;" again, others are slaves to the cup in secret, and it is not known. For 17 years, we knew a gentleman of high attainments, who, through drink, forced a coroner and his jury to examine into his last act, and yet we never heard of his besetting weakness. Though a person may not be an habitual drunkard, he is open to the danger of becoming so, by a sudden change in his circumstances; domestic distress and grief may drive him foolishly to seek rest of mind, by intoxication.

119. Sobriety is an ornament; if this ornament is not in the applicant, we should *decline the case*. We cannot be too strict in searching into these particulars; sobriety and early hours. How shall we venture to define "given to strong drinks"—shall we say, that we think a sober person, to be one, who drinks no more than to quench the thirst, or to strengthen the system, when they feel a need thereto, through debility? If not so, where shall we draw the line?

Drinking with some persons appears to be a kind of disease; they will carefully abstain for months, defy temptation, and suddenly a

certain period arrives for "drinking deep," indeed, many "drink themselves to death, as the expression is, if not *forcibly* prevented; yet in the intervals of sobriety, we might accept such a person for assurance, as beyond all suspicion of being a victim.

120. Third.—*What is the Height and Weight?* If we were allowed to make but *one* observation upon a hundred men, and then to give our opinion as to their state of health, we should select the test of *weight* as the one most sure. We may find a large cavity in the lungs of a person and yet a good expression, we may find a good pulse and good appetite, (as is common in consumption) without sufficient nourishment being received into the system. Finally the "habits" may be regular and good, and yet the weight deficient, and the applicant may be a dying man.

The weight is an expression of the whole man—the volume of his make; a measure of his general health; a measure of his digestive functions; a measure of the vigour of his secretions and excretions. If the weight changes, the constitution changes; the first appreciable evidence of consumption, diabetes, or general debility, is loss of weight, and excess of weight is frequently the forerunner of apoplexy. If we wish to determine how a man's vocation agrees with him, we weigh him, or question him upon his weight, and find we have a steady guide to aid our judgment in the consideration.

Let us suppose 100 prisoners in 100 distinct cells, we should judge of their health by the scales; if they change in weight, they change in health; if they lose weight, nothing can satisfy us that their condition is improving; and, if they gain weight, nothing can make us believe, that their prison discipline is injurious to them. Happily, weight is a test not regulated by any condition of the honour or veracity of the parties being weighed, gravitation never "changes;" it gives the difference between mass and mass, by the same law that makes the day follow the night, or the mountains not to be moved.

Man from his cradle to his grave, is like a burning lamp, existing between waste and supply; if the balance between these two conditions, the waste and supply be disturbed in the lamp, or in man, the lamp burns dim, and the vigour of man declines.

"It needs must wither."

The most fearful insight we ever had of the ravages of diabetes, was manifested by the scales; we saw a man lose 1oz. in 20 minutes, which is more than at the rate of 4lbs. a day.

In life assurance particularly, we consider the subject of weight, and if the applicant does not appear before us, but we examine only a written report upon his health, we make it a rule to have the weight stated; this is our foundation upon which we rest, and from thence reason upwards to the question, eligible or not eligible.

If we have a certain weight, we have a certain height; with a certain height, a certain volume of air from the lungs; with a certain volume, a certain permiability of lung; therefore *from the element of weight*, we beat firmly, a path to the condition of the lungs, the functions of respiration, circulation, and digestion.

122. The weight of man is relative to his height in an arithmetical relation, therefore, from the height we may obtain the weight,* but almost always the height and weight can be taken at the same time, but, if not so, we here subjoin for reference, a table of the height and average weight.

TABLE XII.—Weight of 2650 Healthy Males, of 13 classes in society, at the middle period of life.

Exact Stature.		Mean Weight.				Weight increased by 7 Per cent.			
Ft.	In.	St.	lbs.		lbs.	St.	lbs.		lbs.
5	1	8	8	or	120	9	2	or	128
5	2	9	0	—	126	9	9	—	135
5	3	9	7	—	133	10	2	—	142
5	4	9	13	—	139	10	9	—	149
5	5	10	2	—	142	10	12	—	152
5	6	10	5	—	145	11	1	—	155
5	7	10	8	—	148	11	4	—	158
5	8	11	1	—	155	11	12	—	166
5	9	11	8	—	162	12	5	—	173
5	10	12	1	—	169	12	13	—	181
5	11	12	6	—	174	13	4	—	186
6	0	12	10	—	178	13	8	—	190

This reads—a man of 5ft. 8in. should weigh 11st. 1lb. or 155lbs.,

*See *Med. Chir. Trans.*, vol. 29, p. 167, for the equation,

he may exceed this by 7 per cent., or attain 11st. 12lb. or 166lbs., without affecting his vital capacity: beyond this weight, his respiration becomes diminished.

We recommend the French scales for weighing, as they occupy little space, and multiply 10 times, thus—1lb. can balance 10lbs. An English standard can be connected with it.

123. In weighing, no allowance is made for ordinary dress. We look to ascertain

A. If the weight agree with our table;
B. If the present weight be the usual weight;
C. If the applicant have lost weight; or
D. If he have gained weight.

124. A.—*If the Weight agree with our table.*—If a man's weight is *constant* and agrees with our table, and he looks well, the chances are, he *is* a healthy man. He cannot have consumption, nor, do we ever remember suspecting disease of the digestive system under such a condition. The character of a healthy weight is *firmness*, a certain tone of energy compatible with his age, the arm and thigh feel solid and hard, digestion is good, and, allowing "family history," previous health, and habits to be good, it will be difficult to find evidence to reject such a man. There can be no degeneration of tissue, nor excess of fat, but every part of the body is properly nourished.

125. B.—*If the present Weight be the usual Weight.*

The weight may not correspond with our table, and yet the life be good, but then we should inquire, Is the present weight the *usual* weight, and is it constant? if so, this may be considered the natural weight, though above or below the mean weight of our table. The difference, however, must be limited, allowing a variation to our table, of say 28lbs. deficient, and 14lbs. or 18lbs. in excess; this with a firm character and muscular tone, may still be indicative of a safe life, but it must have been the *constant* weight for years, and we must be relatively more rigid on other points—about the habits of life, general tone of the system, and condition of the internal organs.

126. C.—*If the applicant have lost Weight.*—The applicant will

probably be below the mean weight of our table, though not necessarily so, and may be still losing weight, because, a man with excess of weight, may be losing, and passing by, the mean weight when we examine him, but then his weight is not *constant*, a point absolutely necessary to health.

127. A *slow* and *gradual* loss of weight, is more serious than a *rapid* and *irregular* loss of weight. A person may lose weight, but he cannot do this *gradually* without exciting serious suspicion. A steady loss of weight *always precedes* consumption, therefore, where there is an hereditary predisposition to consumption, with a loss of weight, in from 3 to 5 months, such life we feel must be rejected. A deficient weight tends to show deficient nutrition.

128. An annual and periodical oscilation of weight generally tends to show that his vocation is affecting him, and this will "*tell*" upon his constitution in time. All weight is considered lost weight which is below *our* mean or *his* usual weight; the condition of losing weight speaks seriously against our accepting such lives. We have oftentimes rejected a man from the element of weight alone, particularly when it is not constant.

129. D.—*If he have gained Weight.*—By weight gained, we mean weight *superadded* to our mean weight or the applicant's usual weight, but, if a man has lost weight and is making this up again, such we do not consider as "*gained weight.*"

130. Excess of weight, when it has extended to 7 per cent. above the mean weight, tends to diminish the power of the lungs; for instance, (Table XII.) if a man weigh 158lbs. instead of 148lbs., beyond this line, breathing begins to be affected, (22). A person suddenly gaining weight, to corpuleney, is a dangerous case for assurance; they threaten apoplexy, but from a person *constantly* and moderately corpulent, we think little danger is to be apprehended, because this is his nature; there is, however, a limit to this; an excess of 45lbs. or 50lbs. is a strong objection to assurance. We mentioned the case of the clerk (109) who suddenly gained weight and suddenly died at his desk.

131. When the weight increases from the closing up of an old discharging sore, the individual is likely to die prematurely; and, in

fact, a man with such a discharging wound is a bad life to accept, for we cannot prevent a person healing a sore on his own person, and if he be thin or stout, the chances are, he will either die of apoplexy, or of some hereditary disease, for this is sufficiently an exciting cause to produce consumption, or insanity, or fits, &c., if such be in the family. We knew a healthy gentleman æt. 62, who was never ill—he suddenly dropped down dead—four years before, he had closed up an old issue in his arm. How commonly in these sudden deaths do we hear it remarked, "how well the man looked the other day," he "seemed to have improved lately," beginning to look "jolly." There is another similar and striking case we can mention of a lady now living, æt. 50, who suffers from ulceration in the leg; she likewise has an hereditary tendency to insanity. When the leg is "open" her mind is *sound*, but when the ulceration "closes up" she becomes *insane*; counter-irritation is again applied to the leg, the sore again discharges, and her mind becomes sound again—it closes up, and again she becomes insane—it is opened, and again she becomes sane; these two conditions never exist together. This is a beautiful illustration of an exciting cause acting upon one who has an hereditary predisposition, (81). What is also remarkable, when the leg is discharging, she *gains weight* with the return of a sound mind; when not discharging, she *loses weight* with the return of insanity. The irritation of the mind altering the common rule, of weight increasing with closure of the wound. Such cases are familiar to all, yet we are apt to overlook that which is familiar to us. True, a man may have such an abnormal opening in his body, and yet live the usual span of life; so may a man risking his neck, keep his feet dry upon stilts. These openings when closed, tend to increase the weight of the person. Very corpulent men, are generally regular in "*habits*," and take much exercise; but, should they sprain their ancle, or should any other accident prevent their accustomed exercise, where are they? The "*usual rate*" of assurance will not cover the risk. Excess weight is disease.

132. Fourthly.—*Any illness since childhood?*—Few men pass through life without one illness; yet common is the reply to the life

office, "I never had a day's illness." If an illness be acknowledged, has it left any traces behind? If he has had rheumatic fever or not, the heart must be examined. This organ has justly been termed one of the props of the tripod of life, for our health depends upon its receiving and transmitting a certain volume of blood, to all parts of the body. Disease of the heart is by no means rare, indeed, it is a common disease in this country, and said to be more so in Australia. If a man in that country is flogged, the chances are, he will afterwards have disease of the heart; it is there said to be peculiarly excited by mental distress.* All diseases of the heart, whether in its valves, or substance, or in the covering or lining membrane, tends to shorten the span of life, although some of them may not compromise life immediately.

The displacement of the heart may be congenital; it may be horizontal in position, or it may be situated in the abdomen or neck,† and it is likewise displaced by disease. Although it is difficult to say how far congenital displacement of this organ tends to shorten life, there is, however, accompanying such, more or less serious malformation, and all thoracic malformation injures the respiratory power, another prop of the "*tripod of life,*" and in displacement of the heart by disease, life is always doubly uncertain.

The rhythm of the heart's beat should be regular, its impulse moderate in power, and circumscribed in extent. Laennec considered that in a natural state the heart "ought to be in size equal to the closed hand of the subject, or *only* a little less or greater than that.‡ The palm of the hand over the region of the heart, is a convenient way to measure the extent of the impulse of that organ.

In a well-formed and healthy chest, the beat of the heart in deep inspiration is scarcely perceptible, or when the person is recumbent on his back; on the other hand, the beat is distinctly felt in deep expiration, or when the person inclines his body forwards, or "lies upon his face." If this is not the case, the heart is not loose or moveable, as it naturally should be, therefore, in feeling the

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*We obtained this information from private correspondence.

† *Cyclop. Prac. Med.*, vol. II., p. 389.

‡ *Dis. of the Chest 3rd. Ed., Tr.*,, 8vo., 1829, p. 558.

heart, we can incline the body one way and another, without inconveniencing the applicant, or request him to inspire and expire, while we note these conditions. If these changes of impulse, do not accompany these changes of position, probably there are abnormal adhesions. Such an examination as this is probably too minute for a "Life Office"—the applicant should not be personally much disturbed, or he may go to some other office where he may be less so.

To the ear, there should be no blowing or rasping sound, indeed, little appreciable sound, because the volume sound, and the valve sounds, are not strong; the chief phenomenon of the heart is its impulse, which *the ear feels;* whilst we listen for the sounds *in the* impulse. The Great Creator has adjusted the volume of blood to be transmitted through the heart, with such precision, that no rushing sound is heard, but if *this* relation between the volume of blood, and the openings be altered (which only can be done by disease), a blowing or rasping sound is heard. We need not add our decision in such cases.

The heart may have an inordinate rhythm and impulse, from what is termed nervousness, caused by the formidable expectation of appearing before the doctor; but this quickly subsides, or begins to subside when the visit is realized, but if this beating does not begin to subside, probably there is something in the "history" of the applicant, relative to health, kept secret from us.

Generally the *beat* of the heart is explicit, because it is not under control.

Independantly of nervous derangement of the heart's beat and impulse, there may be palpitation and intermission, or irregularity of the pulse, from some disordered condition of the stomach—a complaint so common, that tea, smoking, or any form of diet may produce these derangements, but the chief difference which distinguishes such irregularity, from that of organic disease; consists in the former not being constantly present, while the latter is so. A high authority states,* "Nervous palpitations are apt to come on when the patient is quiet at rest: palpitations that result from

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Dr. Watson's *Prac. of Physic*, 8vo, 1848, London; vol. i. p. 247.

organic disease, on the contrary, are mitigated, usually by repose." However, we must remember, that gastric irritation often attends organic disease of the heart, therefore, the cardiac derangement from gastric disorders, should be well considered. But when such irregularities are purely of a nervous nature, or from mere dyspeptic derangement; other points being favourable, the case we should consider as eligible.

133. In health, there is a certain relation between the heart's beat, and the number of the respirations.

134. *Healthy number of pulsations and respirations per minute.*—These functions, particularly the latter, being remarkably sensitive to mental emotion, some latitude must be made for their relative irregularities; and such irregularities must not be taken (when unattended with other symptoms) as weighing against a case. Generally the heart beats 4 times for each breathing movement, yet 6 long and deep ordinary respirations may be equal to 24 quick and short respirations.

The respiratory function has a PECULIAR power to adapt itself for drawing in any quantity of air, by modified movements; hence, a man *may* be in perfect health who breathes 6 or 24 times, to 75 or 80 pulsations per minute; for by a modified movement the *quantity* is regulated, whether taken in by 6 or by 24 inspirations. Therefore, before a case is rejected upon the score of the number of respirations per minute, their character as LONG OR SHORT, together with the ANIMAL TEMPERATURE, should be noticed.

If the animal temperature feels higher than natural, say at the wrist, and the respirations are too weak, without previous extra exertion, the case is not healthy and had better, at least, stand over for a time.

135. The author has noticed 9 respirations to 100 pulsations per minute, from temporary derangement—mere nervousness from examination; but this character of respiration is well marked, and need never be mistaken for the quick, irregular, and feverish respiration of diseased breathing.

136. When the respirations are counted, the individual must *not be conscious* of the observation, otherwise they become disturbed. Therefore, the observer must pretend to be feeling the pulse with

his hand resting on the abdomen if a male, and on the thorax if a female, when both the pulse and respirations can be numbered.

TABLE XIII.—NUMBER OF RESPIRATIONS PER MINUTE *(Sitting)* IN 1897 HEALTHY MALES.

RESPIRATIONS..FROM	9 TO 16	16	17	18	19	20
NUMBER OF CASES..	79	239	105	195	74	561

RESPIRATIONS..FROM	21	22	23	24	FROM 24 to 40
NUMBER OF CASES..	129	143	42	243	87

Out of 1897 Cases, 1731 breathe from 16 to 24 times per minute, and nearly ⅛ of them 20 times per minute.

TABLE XIV.—RELATION BETWEEN THE RESPIRATIONS AND THE PULSE *(Sitting)*, IN 1407 HEALTHY MALES.

No. of Respirations per minute	Pulse.	No. of Cases.
16	64	218
17	82	102
18	70	176
20	82	546
22	83	135
24	88	231
MEAN 18	78	

From this Table, though the mean is about 4 pulsations to 1 respiration, yet a latitude may be allowed for the ordinary respiration, varying from 16 to 24 per minute; and for the pulse, from 64 to 88—without weighing in the least against the case—when unattended with any other bodily derangement.

137. Has there been any important disease of the lungs? We must see if the ribs expand sufficiently; to determine this, we must take the vital capacity by the Spirometer; if this corresponds with the mean of our table (p. 4) the lungs expand well and are

permiable to air. At times this is a most useful test, particularly when the weight is below par and consumption threatens. Dr. Shearman found this observation of some value, according to the following letter:—

Rotherham, 18th July, 1847.

My Dear Sir,

I beg to tender you my best thanks for your invention of that very useful and invaluable instrument, your Spirometer; I have now used it about eighteen months, and I wonder how I ever got on in practice without it before. In all chronic diseases of the chest, the vital capacity of the lungs and the varying weight of the patient, give such correct data, that I feel sure, in time, no well educated medical practitioner will feel comfortable to be without such assistance.

Some time ago, a gentleman called on me, as the medical referee for an insurance office, to be examined for a very large insurance on his life; he produced two certificates from two most respectable physicians, stating his health to be perfectly good, and in fact, he looked quite well: on trying him with your Spirometer, he was 85 cubic inches less than he ought to have been for his size, age, and weight; and although I could not then detect any positive disease in the chest by auscultation, I considered it right to state my reason for refusing to certify his health to be good—and his policy was refused for £2000. He is now, only eight months after, in a confirmed consumption. I saw him only a few days since. But for your invention this office would have lost the money. I now never examine a person for life-assurance without trying him on the Spirometer, and feel persuaded, if it were generally used, many lives would be refused which are now taken.

With every wish for your success to the utmost of your expectation,

Believe me,
My dear Sir,
Yours very faithfully,
E. J. SHEARMAN, M.D.

John Hutchinson, M.D.

138. In the absence of the Spirometer, we use the tape measure, (13) and the mobility should be 3 inches, *i. e.*, the expansion and

contraction of the chest over the nipples by deep inspiration and expiration, should alter its circumference 3 inches; if less than this, thoracic disease of some kind is present. Also the character of this movement is peculiar to health, as tested by the hands over the apex of the chest, (14).

139. The character of healthy breathing, is to swell up the apex of the chest, the ribs moving with a kind of undulation; this is incompatible with disease of the lungs; such movement is particularly well marked in females. No unnecessary exposure of the person is required, it can be equally well determined over the clothes.

We may wish to auscultate the chest, if so, we must listen for *two* things. Is the *expiration* audible and is there a resonance of the voice under the *left* clavicle, at its acromial extremity? If so, unless the voice be very deep bass, this, as well as the expiratory murmur, is morbid. (48—68.)

140. If this is not present, the respiration shou'd be soft, ample, and penetrating, and also at the symmetrical point on the right side, a slight vocal resonance and expiratory murmur is natural, and the tips of the shoulders should point *backwards*, at least *not* forwards or inwards. If the shoulders do point forwards and inwards, the case looks unfavourable; for the chances are, that consumption has commenced. Neither vocation, age, nor any other disease than co sumption produces this character of stoop; therefore—

141. If the family history is good, the habits of life and previous health good, the weight constant and about the mean, (Table XII) no abnormal openings in the body, no abnormal blowing or rasping sounds, &c., of the heart, and the chest expanding well, we then feel tolerably sure that the thoracic and abdominal organs are sound, and that the "life is good" and safe for assurance; on the other hand, if hereditary disease is in the family, uncertain habits, an excess, or losing, or light weight, or deficient vital capacity, such cannot safely be received at the "ordinary rate."

142. Very much information is obtained by simply feeling the arm; if two men, say of 5ft. 9in., each weighing 162lbs., (a good weight), and one of them has been, say 180lbs. and lost 18lbs. the arms of these men will not feel the same, one is firm and the other flabby; this observation alone is of much value.

143. Observations upon females are more difficult. We never heard a woman acknowledge that she wore her clothes tight, and we have put this question to thousands, and yet we believe a *certain* number do wear *tight* dresses; the discrepency probably all hinges upon our understanding of the word *tight*.

144. Quetelet observes, that at equal ages man is generally heavier than woman; about the age of 12 years only, are individuals of opposite sexes nearly of the same weight. This circumstance is owing to the development of the weight being inconsiderable in both sexes until the time of puberty, when on the contrary it becomes very apparent.

Man reaches his maximum of weight at about the age of 40, and he begins to waste in a sensible manner at about the age of 60; at the age of 80 he has lost about 16lbs. (troy.) His height has also diminished about 2.7 of an inch. The same applies to females, they generally lose from 16lbs. to 17½lbs., (troy) and 2.7 of an inch in stature.

It is probable that women attain their maximum later than men, weighing most at about the age of 50 years, setting out from about the age of 19, the development of their weight is nearly stationary until the period of child-bearing is passed.

Our table of weight is taken between the ages of 15 and 45, and should hold good up to 60 years of age.

145. The examination of women for assurance, we have noticed, is more difficult than that of men. Their dress not only prevents stethoscopic observations, but prevents that free movement of the chest which is peculiarly natural to them, hence their vital capacity cannot be correctly ascertained. However, much may be obtained by observing the "*look*" in combination with the *weight*; the look alone cannot be depended upon, for oftentimes the appearance of the face and hands is *unexceptionable*, although a cavity is present in one or both lungs. Happily, it is not difficult to come to a safe conclusion as to the presence or absence of pulmonary disease in women, by the combination of one or two observations.

First. *Breathing.*—When a woman sighs or breathes deep, the chest movement should be symmetrical, the infra clavicular regions

swell up remarkably, and this, with an undulating character of movement, somewhat like the slow onward roll of a large smooth wave; this can be determined by the hands, (14.—139), or even by the eye. If we notice the public female singer, how her chest expands! We want a like expansion.

Secondly. *Form.*—The tips of the shoulders should be directed *backwards*, (29.—140), and

Thirdly. *Weight.*—This must be good and constant.

Therefore, with such a breathing movement, direction of shoulders, and weight, we CANNOT have phthisis pulmonalis, nor asthma, nor bronchitis, nor emphysema, nor any thoracic deformity.

A woman under 45 years of age, whose mother has died of consumption, particularly shortly after her birth, is a hazardous risk at the ordinary rate, (Table VI.—par. 85). Our stethoscopic observations apply equally to women as to men.

146. Hæmoptysis, or what in popular language is generally termed "breaking a blood vessel," is not of an uncommon occurrence. But blood from the mouth may come from the posterior nares, gums, stomach, or lungs, and it is at times difficult, and always necessary, to know from whence the source. The applicant may say, "*I have spat blood.*" Blood from the posterior nares or gums is commonly easily recognised, the former being generally felt coming down, without a cough, from the upper and back part of the mouth, and probably accompanied with bleeding from the nose; and, if the blood be from the gums, the predisposition is generally noticed when brushing the teeth; these, therefore, we pass over.

Blood from the lungs is, in nineteen cases out of twenty, a quick forerunning symptom of consumption, while blood from the stomach, certainly is *not* a symptom of consumption.

Out of 1758 consumptive cases at the Brompton Hospital, 62 per cent. had hæmoptysis in an early stage of that complaint, and, with reference to the liability in the sexes, it was in the men to the women, as 62 to 64. Hæmoptysis, therefore, is nearly equally common as a sign of consumption in men as in women, the only difference being as to the age of the sex when it appears; in women at or before the age of 35, and in the men for 15 years later.

Blood from the stomach is much more common from women than from men, and that at a period not later than 35 or 40 years of age, whereas, in men, seldom earlier than 35 or later than 50 years of age.

In women, blood from the stomach is frequently excited by violent mental emotion; in this way, we have known four or five ounces, brought up at one vomit, within a few minutes after the person witnessed the object of her emotion; again, this discharge is very commonly excited from a suppression of particular female functions.

When a man vomits blood, it is almost invariably produced by those habits and pleasures which are not favorable to health—from the rupture of some large vessel—organic disease of the heart, or other causes no less serious.

The subject therefore, viewed in outline, is, that hæmorrhage from a man is much more serious than from a woman, the chances being, that the man's life is not worth more than three or four year's purchase, while the woman's life may be uninjured by it, provided we see the collateral conditions of health favorable.

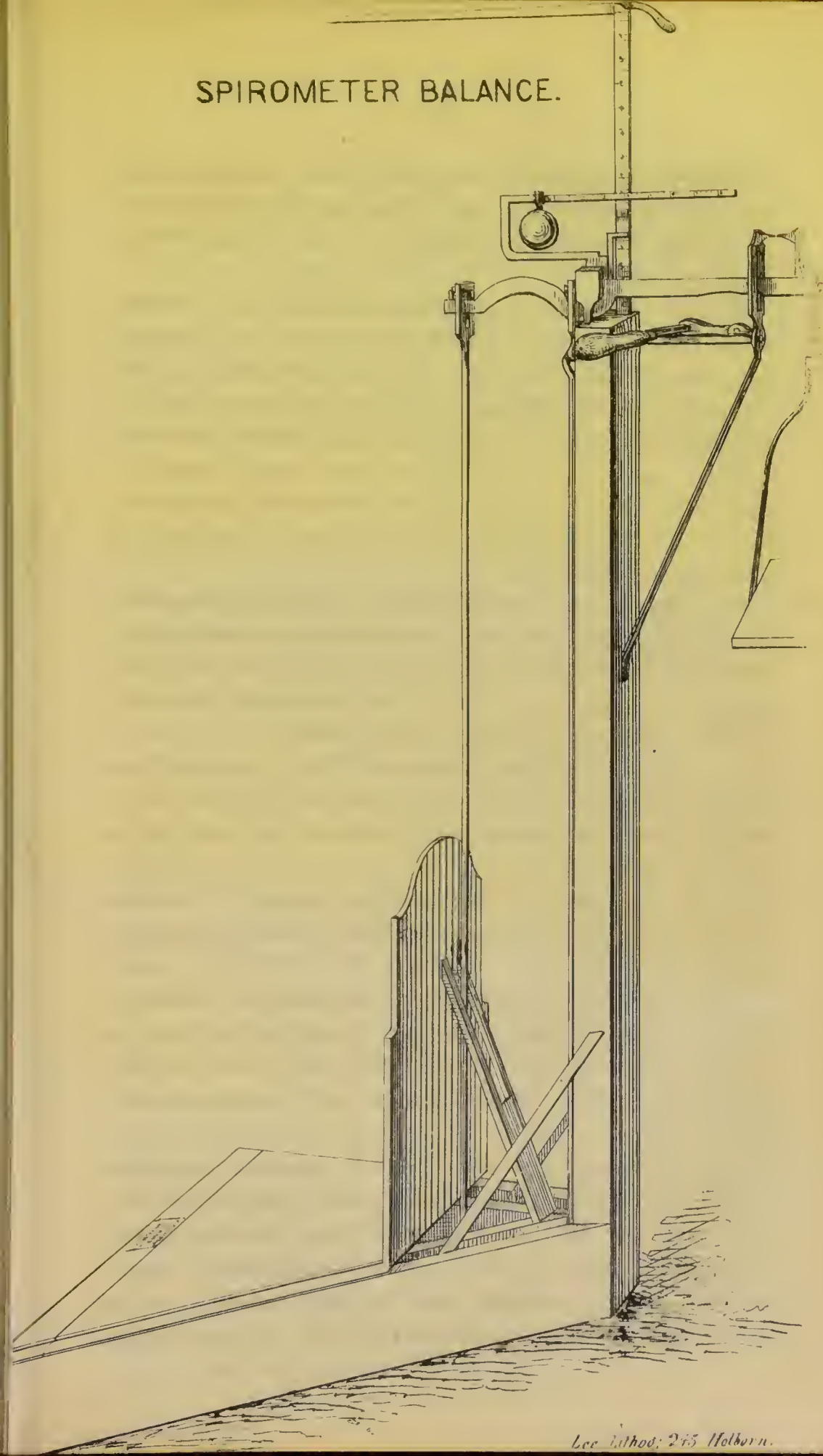
To return to the applicant's statement, "I have spat blood," and it is for us to determine from whence, the stomach or the lungs? For upon this, we probably accept or decline the case, and here we venture a few general rules.

First. *As to manner.*—How was it brought up? If from the stomach, it is generally vomited or eructated, if from the lungs, it is generally coughed up.

Secondly. *Character.*—Blood from the stomach is generally in clots of a dark grumous appearance, probably mixed with the contents of the stomach; when from the lungs, it is not often in clots, but mixed with the saliva, appearing of a light red or deep pink colour.

Thirdly. *Quantity.*—When from the stomach, generally the quantity is by mouthfuls or in clots not less than a filbert, when from the lungs, the quantity is less at a time, as if the result of some oozing. But the quantity may be only a streak, a quantity not measureable, and probably seen but once or twice; if this has been accompanied by a severe straining cough, we would not call

SPIROMETER BALANCE.



Lee, Lithog. 265 Holborn.

this hæmoptysis. When hæmoptysis comes on in the latter stages of consumption, then the quantity may be equal to any quantity from the stomach—but such cases as these never appear for assurance.

Fourthly. *Duration.*—When blood comes from the stomach generally the discharge is quickly over, a few vomits and then a cessation; but when from the lungs, the duration is probably for days, or at least longer than the common period of vomiting.

These are general remarks, and though we have seen many individual exceptions, yet this matters not, because such exceptions are seldom likely to be cases of doubt.

Should it happen that the only information we can obtain is, "I spat blood," then it is for us to consider the time since elapsed.

We are disposed to say that a slight hæmoptysis of, say a table-spoonful, coughed up *five* years ago—with no loss of weight—nor hereditary predisposition, good circumstances, and good breathing movements, we would be inclined to accept the case, but not so, if it occurred within *three* years.

We speak this from general observation, and not from any statistical record; therefore it must be valued accordingly.

147. Although women are less exposed than men, to the influence of particular agents, as weather and physical accidents, yet they are exposed to a danger peculiar to their sex—pregnancy. More than 2000 women a-year die from childbirth in England. The chief risk is in first labours, which being more difficult than subsequent labours, are hence more dangerous. We regret we cannot at present offer any exact data as to this relative danger, beyond the opinion, that the ordinary addition for expected labour in general, should not be considered enough to cover the risk of first labours.

148. Cancer.—This is a malignant disease, occurring at certain ages and with different intensity in the sexes. Women are more subject to this disease than men, as 32 is to 12, or as by the Registrar-General's Returns for 1847, as 3288 is to 1298. There are good grounds to believe that it is hereditary, and that circumstances do not predispose to it; but when predisposed to it, common causes, as blows, anxiety of mind, depressing passions, poor food, unhealthy labour, unhealthy localities, and irregular "habits," commonly become exciting causes to bring it forth.

The female breast and uterus are peculiarly subject to this disease; but indeed, unhappily, we add, that scarcely any organ of the body is exempt from it,—as the brain, the eye, the ear, the lip, the tongue, the face, the lungs, the stomach, the intestines, the liver, the kidneys, the general organs, and the bones.

However, as already noticed, the breasts and the uterus, or those glands, the functions of which have been interrupted or have never been performed, as before and after child-bearing, or where women have never had children, there we find the greatest liability of the disease to appear.

Cancer may be quick or slow in terminating the life of its victim; from two or three years, to thirty years; but generally the health soon suffers, the countenance becomes sallow or pale—the strength declines, and perhaps for years periodically the pulse is preternaturally quickened. When the disease attacks the intestines, there is a tendency to habitual costiveness, eructations and painful distension of the abdomen—without loss of appetite—at times liquid evacuations, with blood, which may be referred by the sufferer to hæmorrhoids only. Immoderate use of spirits excites the disease in the stomach. Some authors have believed, that cancer is indicated by a peculiar expression and complexion; "a blue tint mixed with brown," chiefly conspicuous under the eyes, or on the parts usually fair; this refinement may or may not be true for ought we know; however, of this we are certain, that disorganization of the lungs and brain, cannot be detected by the expression or complexion. A man may die raving mad, yet afterwards nothing abnormal be apparent in the brain; or, on the other hand, a brain may present the sign of acute inflammation, yet the man may have never exhibited any peculiarity in manner or expression. The same in consumption —a man may "*go about*" looking like an attenuated corpse, with scarcely any appreciable disease in the lungs; or, he may have an unexceptionable expression and complexion with cavities in both lungs. Therefore, we believe that there is not necessarily a corresponding appearance between the expression and complexion, with internal malignant disease. The obnoxious period for cancer is like apoplexy; late in life increasing with advancing years: as may be seen by the following Table:—

TABLE XV.—Showing the absolute Mortality by Cancer in England in 1847, and the Mortality at 12 periods of life, relative to 100,000 living; or 51,023 Males and 48,977 Females.

Years.	Actual Mortality in England.		Relative Mortality by Cancer to the living.		Per cent. dying by Cancer to 100,000 living.		Living.	
Age.	Males.	Females.	Males	Females.	Males.	Females.	Males.	Females.
0 — 5	29	39	9	9	0.02	0.02	51,023	48,977
5 — 10	9	12	6	5	0.02	0.01	34,358	33,971
10 — 15	7	9	2	0	0.01	0.00	32,623	32,298
15 — 20	17	11	0	4	0.00	0.01	31,904	31,636
20 — 30	53	98	7	6	0.02	0.02	30,878	30,806
30 — 40	88	285	25	62	0.08	0.21	28,099	28,569
40 — 50	166	699	33	192	0.13	0.75	24,443	25,409
50 — 60	311	894	69	294	0.35	1.35	19,635	21,674
60 — 70	314	724	55	259	0.40	1.58	13,539	16,300
70 — 80	223	401	41	113	0.58	1.20	6,973	9,371
80 — 90	72	103	3	21	0.16	0.77	1,779	2,723
90 — ×	9	13	0	0	0.00	0.00	134	226
Total ...	1298	3288	250	265				

The table reads thus:—At 50 and under 60 years of age, there died in England, in the year 1847, of cancer, 311 males and 894 females; also 19,635 males are living at 50 years of age, and out

of these 69 males and 294 females die of cancer in the next ten years, or, relative to the living, 0.35 per cent. males, and 1.35 per cent. females.

The intensity of death, like apoplexy, is from 40 to 80 years of age, and strikingly greater in females than in males.

Allowing that cancer is an hereditary disease, which though some may doubt, yet none will deny, the deductions to be drawn from the last table relative to life assurance, are very similar to those drawn from the corresponding tables on consumption and apoplexy, pages 46 and 47, and given under *deductions*, par. 99.

Where it is in the family, depressing causes, as well as physical accidents, are liable to excite it, (par. 111—148); therefore, suppose a widow lady at 40 years of age, wishes to be assured, whose mother died of cancer, the risk against the office, is too great at the ordinary premium; because she undoubtedly is, for the next ten years subject to a "critical" change, through which she must pass, in combination probably with a certain amount of mental depression. We should not even be happy in assuring a man in middle life, who has not these depressing conditions, allowing there to be evidence that his father died of cancer. We have seen cancer pass through three generations on the male side, in advanced life.

Although we acknowledge that it is not prudent, in this class of enquiry, to advance solitary cases to support a general deduction, yet we venture to notice in passing, that Buonaparte died of cancer in the stomach, when a prisoner in St. Helena, under the rigid discipline of Sir Hudson Lowe,—a condition not a little depressing, and that his father died before him of scirrhous pylorus.* Surely if physical strength could have warded off the hereditary predisposition, we might have looked for this in the Emperor,—a man who had endured every deprivation, and passed through vicissitudes so great, that many who followed him through this path, slept the sleep of death. How great is the value of family history, with reference to the prospects of life.

149. *Of the senses.*—Although we hold communication with the

*See "Last Illness of Buonaparte, &c." by Archibald Arnott, 1822.

external world through the medium of our five senses, yet we may have a case in which three out of the five may be lost, and yet accept the same at the ordinary premium.

We would not reject a man because he could not smell, or taste, nor yet a man totally blind. A blind person can either take care of himself or he has some one to take care of him, therefore he is taken care of; but a man partially blind is a bad case; because he chiefly depends upon an imperfect sight, and probably unattended by a guide, consequently he neither has the tact of a blind man, nor the vision of a clear-sighted man, to warn him of danger. We have rejected such a man upon these grounds.

Perhaps hearing is the most important sense, for the protection of life; however the deaf and dumb are more particularly under the care of others. The loss of hearing is a loss to all warning sounds of personal danger;—the bustling city, to the deaf man, is like a dream,—a bustling but silent city. We have known a deaf and dumb man accepted at the ordinary rate, but we have never had an opportunity of examining such for ourselves.

There is no reason to think that the loss of a sense shortens life, any more than the perfecting of a sense lengthens life. In all such cases as these the chief points to be considered are, the "*circumstances of life,*" and the *requirements* demanded therein—the vocation, and the exposures attending that vocation.

ERRATA.

Page 5, line 9, from the top *for* "measurement," *read* "movement."
Page 7, line 10, from the top *for* "oxygentrated," *read* "oxygenated."
Page 11, line 9, from the top *for* "infiltration," *read* "infiltration."
Page 15, line 5, from the bottom *for* "3," *read* "4."
Page 27, line 8, from the bottom *for* "acromnial," *read* "acromial."
Page 31, line 8, from the top *for* "pereumonia," *read* "pneumonia."
Page 62, line 11, from the bottom *for* "weak," *read* "quick."

MANUFACTURE OF THE
SPIROMETER, SPIROMETER-BALANCE,
AND
STETHOSCOPE.

150. The SPIROMETER requires more care in its construction than is commonly believed; it is not merely a measuring gasometer; as such it may be mathematically correct and the workmanship may be exquisite, yet not correctly measure the vital capacity.

A man who attempts to furnish an "*Improved Spirometer*," may have an exquisite workman to carry out his views, but probably the two men lack the experience of knowing the numerously different ways men have of breathing. We have seen Spirometers sold which never can agree with our table of vital capacity, yet they profess to do so.

A Spirometer must as it were elicit the air out of the lungs; if it causes the least resistance to be *tailed back* upon the expiratory muscles, which muscles are as sensitive as the horns of a snail, they will in turn *give back*, and not force out the complete vital capacity volume.

The Spirometer is *correctly* manufactured at Mr. EWART's, Quickset Row, New Road; and may be obtained of Messrs. NEGRETTI AND ZAMBRA, Mathematical Instrument Makers, 11, Hatton Garden, London; finished in a becoming manner, for the consulting room or for Life Offices.

SPIROMETER-BALANCE.—The scale we recommend for weighing, IS REPRESENTED in the annexed figure, with a standard connected to it. This is a modification of the French scale, multiplying ten times; they wear remarkably well, and will tell the weight of a man within two ounces. We have used many kinds of scales, but have found none so correct and lasting as the kind in question. This Balance can be obtained of Mr. W. POUPARD, Scale Maker, 30, Wych Street, Strand, London, price not exceeding £8 8s.

STETHOSCOPE.—The Stethoscope we find best calculated to convey sound, is constructed with peculiar *lightness;* although seven inches

long, it weighs little more than 100 grains. It is trumpet-shaped the ear-piece moveable; so that one end (which is smaller than the other) can be applied to the supra-clavicular fossa, and the larger end to other parts of the chest.

The lightness of the instrument also prevents the ear-piece chipping by a fall; an accident as common as it is inconvenient.

This Stethoscope may be obtained of Mr. Wm. Henry Spratt, Truss Manufacturer, &c., 2, Brook Street, Hanover Square, London.

CONCLUSION.

151. We lastly add, that it is with some timidity we venture these few sheets before the public, because, not professing perfection, we do feel that the more we labour, the more we experience the lack of knowledge.

The remarks upon the Spirometer are chiefly a collection of facts gathered by years of labour, especially arranged, to answer the common questions put to us upon the subject; if these prove as useful to the reader in examining the chest, as the facts themselves are true, we shall be pleased.

Our observations upon the Stethoscope may be viewed as neither new nor yet original; but indeed it is not our object to seek the new, nor yet to be original, but more to work out that which has already been considered. The Stethoscope was formerly to us the most confused and complex subject; or probably it would be more correct to say, that we, were the confused and complex subject. Nevertheless, wherever the complexity was, it is now gone; and by this we wish it to be understood that the application and value of the Stethoscope can be thoroughly comprehended by *any one*.

The few pages upon selecting lives for assurance, contain that only which we have derived from experience; and our having committed such to paper, was induced by feeling a certain want of unity of system, particularly amongst non-Army medical referees, in the method of selecting lives. Believing at the same time a nucleus is a nucleus, though never so imperfect, upon which others can improve, so that in time, an unity of system, may be obtained amongst medical referees, as perfect as in any other branch of life assurance, is what the Author begs to offer as an apology for his imperfections.

CONTENTS.

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